Teachers, Learners and Mathematics: an analysis of HSRC research reports on mathematics education 1970 - 1980

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I hereby declare that this dissertation is my own unaided work and that all sources of reference have been acknowledged. The dissertation is submitted for the degree of Master of Education at the University of Cape Town. It has not been submitted before for any degree or examination at another university.

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this 16th day of April 1997

Abstract

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The dissertation is concerned with the production of a systematic analysis of HSRC research reports into mathematics education in South Africa between 1970 and 1980. Drawing on the theoretical language of Dowling (1995), the analysis focuses on the (re)production of voice and message in the reports. This entails an analysis of positioning strategies that mark out voices in the texts and distributing strategies that distribute message across voices. Voices include bureaucratic, academic, teacher and learner voices and knowledge and practices that constitute message distributed to voices relate to mathematical knowledge, pedagogic knowledge and curriculum innovation practices. Positioning and distributing textual strategies with respect to learner and teacher sub-voices are related to the (re)production of theories of instruction that constitute models of acquirers, transmitters and pedagogic contexts and define pedagogic competence in particular ways. The (re)production of theories of instruction in turn are related to the reproduction of social relations in the broader society. It is hoped that the analysis illustrates the generality of Dowling's language for analysing texts.

The substantive focus of the study is the analysis of the reports and the language developed in the analysis is used to make some suggestive comments about current mathematics curriculum development in South Africa. It is hoped, in particular, that the focus in this study on discourses in mathematics education in South Africa in the 1970s will contribute to the documenting of the history of mathematics curriculum development in South Africa.

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Table of contents

List of Tables and Figures

Figure:

Tables:

Chapter 1

Introduction

1.1 Motivation for study

The motivation for this study developed out of two interrelated curiosities. The first arose in relation to the newly implemented curriculum for mathematics at all levels from 1994 in South Africa. First drafts appeared in 1994 and implementation dates were set for 1995, 1996 and 1997.[1] The introduction of this curriculum was accompanied by a national inservice education programme to suggest implementation. It was claimed at the time by many in the field of mathematics education in SA that the new curriculum contained minor changes to mathematical content, with the main concern centring around changes in pedagogy. "New" discourses in mathematics education, with emphases on "child-centred" pedagogy, flexible teaching styles and continuous and varied assessment, were seen to challenge the "traditional" transmission teaching of the past. It was promoted as the "new" curriculum for the "new" South Africa.

My curiosity centred around the novelty of this curriculum, that is, how different was it to curricula of the past and to what extent did this "novelty" reflect the new political dispensation? It was the former question that sparked my second interest, which relates to the historical development of mathematics curricula in SA. There are no known systematic studies on the historical development of mathematics curricula in South Africa. The only "historical" documents that exist appear to be those which emerged from research conducted by the South African Institute for Educational Research, an institute of the state-aided Human Sciences Research Council (HSRC) in SA. The documents are part of a research project launched in 1970 on mathematics education in South Africa and spans ten years, the last report dated in 1980. The

[1] These curricula have subsequently been superseded by new outcomes based curricula scheduled for implementation as from 1998.

research reports which emanated from this project are significant because they represent a corpus of research dealing with the teaching and learning of school mathematics in South Africa in the 1970s. They are of interest furthermore because at least one of the HSRC commissioned researchers, now the director of a research unit into mathematics education at Stellenbosch University, and his colleagues, were actively involved in the production of the current curriculum. These two curiosities, one relating to the current curriculum and the other to the history of curriculum development, came together in the decision to focus on the HSRC reports for the purposes of this study.

The decision to undertake an analysis of the HSRC research reports was thus motivated by a desire to engage with the history of school mathematics curricula in South Africa and to consider the extent to which issues taken up in the reports prefigure the "new" mathematics curriculum. The study therefore hopes to make a contribution to the curriculum history of school mathematics in South Africa and enable critical comment on the development of the current school mathematics curriculum in South Africa.

The study was initiated by a concern with pre-figurement, that is, the extent to which issues in the HSRC reports foreshadowed the new school mathematics curriculum. In order to address this issue I needed a mechanism to mark out what was changing. That is, I required a language that would enable me to describe the reports and at the same time provide a lens for looking at current curriculum changes. To achieve this I needed to produce a systematic analysis of the reports. This became the central focus of the study, with the issue of pre-figurement becoming to a large extent backgrounded. The central achievement of the study is therefore the analysis of the reports, and the engagement with current curriculum documents is a suggestive, rather than a rigorous engagement which I take up in the final chapter.

1.2 Description of empirical texts

In December 1970 the Institute for Educational Research of the Human Sciences Research Council (HSRC)[2] launched, at the request of the Mathematics Association of South Africa (MASA),[3] "a comprehensive research programme covering numerous aspects of the teaching of Mathematics in the RSA[4] at primary and secondary level" (HSRC Report 0-62). The all-embracing aim of the research programme was "to foster the instruction of Mathematics in South Africa" (HSRC Report 0-13: 1). Seven research reports were produced between 1970 and 1980 as part of this research programme and all of them contain explicit recommendations based on their research. Most of the reports express the wish that their recommendations be taken up officially[5] by curriculum planners and syllabus designers. I shall briefly summarise the contents of each report with its title, in chronological order.

1. Report (0-13): *The aims of mathematics instruction and the problems in connection with innovation in respect of the teaching of this subject in South Africa* (Human, P, 1975)

This report makes recommendations with regard to the aims of mathematics instruction in South Africa. It discusses the nature and significance of mathematics in terms of its relation to everyday activities, as a method of research, as a source of wonder, as a medium of communication and its significance to labour. The aims of mathematics instruction include the handling of the quantitative and formal aspects of everyday situations, the development of communication potential, mastery of contemporary reality by insight and comprehension, vocational orientation, development of mathematical potential at different levels, the development of logical and abstract reasoning and preparation for further study. The report also discusses

[2] This was a para-statal institution, which conducted commissioned research mostly for government departments.
[3] A professional association of mathematics lecturers and predominantly secondary teachers, exclusively for whites until the late 1980s.
[4] Republic of South Africa.
[5] See HSRC Reports (0-13: 47), (0-29: 47), (0-44: 129)

factors which have an effect on classroom activities such as syllabus composition, external examinations, composition of textbooks and the training of teachers.

2. Report (0-29): *The instruction of mathematics at secondary school level in a number of countries in Western Europe* (Human, P, 1976)

This report reviews curriculum innovation programmes in The Netherlands, West Germany, England and Wales and Belgium. It focuses on methods of examinations, methods of providing new textbooks, methods for training and retraining of teachers and principles upon which the new curricula in each country were established. Data was collected by interviews with mathematics teachers, principals, inspectors, administrative education officers, researchers and university lecturers and libraries. The reports conclude with recommendations for the organisation of curriculum innovation in South Africa. This entails procedures for bureaucratic management of curriculum innovation programmes in South Africa.

3. Report (0-31): *The training of mathematics teachers in the Republic of South Africa and in some Western countries* (Van den Berg, D.J, 1976)

This report surveys the training of mathematics teachers at white teacher training colleges and selected universities in South Africa. It details the various mathematics education courses for prospective teachers and makes recommendations for the future training of primary and secondary mathematics teachers.

4. Report (0-44): *Design and implementation of criteria for the compilation of differentiated mathematics syllabuses* (De Waal, D.J. & Van den Berg, D.J, 1977)

This report makes recommendations for the design of criteria for selecting subject-matter for the compilation of differentiated mathematics syllabuses as well as criteria for the arrangement of subject contents in mathematics syllabuses. These criteria include learning readiness of pupils, aims of mathematics instruction, the nature of mathematics and differentiation as a criteria. It discusses differentiation of pupils with

regard to IQ, cultural backgrounds and various personal attributes of learners. Finally, it makes recommendations for the compilation of differentiated mathematics syllabuses for South African schools.

5. Report (0-71): *Research trends with regard to the instruction of mathematics in some Western countries* (Van den Berg, D. J, 1978)

This report reviews research in the field of mathematics education in West Germany, Belgium, the Netherlands and the United Kingdom. It discusses papers read at international mathematics conferences and activities of research institutes in the various countries. The research focuses on the aims of mathematics instruction in these countries, criteria they have used for differentiated curricula and methods for the training of teachers.

6. Report (0-75): *A pedagogical study of the black man's mathematical ability* (Van den Berg, D. J, 1978)

This report sets out to describe "factors in the education and traditional culture of the Black child which possibly contribute to the tendency to rely on rote learning". The black learner is described here as "different" to the white learner. Recommendations are made for adapting mathematics instruction and subject contents especially for the teaching of black learners.

7. Report (0-96): *Group-oriented education as a means of promoting black pupil's insight into mathematics* (Van den Berg, D.J, 1980)

This final report in the corpus outlines in detail differences in styles of "upbringing" between black and white pupils as a way to motivate for a completely different form of instruction for black pupils. The argument is that group-oriented education is more in line with the "traditional culture" of the black child and will therefore develop the mathematical potential of black pupils more effectively.

1.3 Organisation of chapters

Literature on curriculum studies in general, and mathematics curricula in particular are reviewed in Chapter 2. The studies relate to curriculum studies internationally and in South Africa. The chapter is intended to locate the study within the context of curriculum studies and focuses on issues around curriculum construction. These include factors that influence curriculum knowledge and incorporate agents/agencies of curriculum reform and change. The literature survey is extended in chapter 3 to look at different approaches to curriculum theory in South Africa. The purpose of this chapter is to establish my own theoretical approach and to develop a methodology for analysing the reports. Dowling's (1995) theoretical language, which is used as a methodological framework in the analysis, is discussed in this chapter. His language provides a framework for analysing texts in terms of *message* and *voice*, which are defined as textual instantiations of *practices* and *positions* of an activity, the activity being school mathematics. The method of analysis entails an examination of textual strategies that constitute message and voice in the reports. These strategies are referred to as positioning and distributing textual strategies.

Chapters 4, 5, 6 and 7 entail the analysis chapters. Each chapter considers positioning and distributing textual strategies, and the resources they recruit, to constitute message and voice in the reports. Chapter 4 produces a voice typography across the reports and looks at message distributed across voices. Voices include teachers, learners, academics and bureaucrats. Knowledge and practices which are distributed to them to constitute message, relate to mathematical knowledge, pedagogic knowledge and curriculum innovation practices. Chapter 5 looks at positioning and distribution of practices in relation to acquirer sub-voices and chapter 6 in relation to transmitter sub-voices. Here, the analysis looks at ways in which mathematical and pedagogic knowledge, students and teachers are (re)produced and the social relations imbricated in this (re)production. More specifically, the analysis looks at how students and teachers are positioned, within and between groups, and how knowledge is distributed to them. These two chapters establish theories of instruction that constitute models of transmitters, acquirers and pedagogic contexts. In Chapter 7, the analysis considers

the textual resources that are recruited to establish positioning and distributing discussed in the previous two chapters. The resources discussed entail the recontextualising of various discourses to constitute pedagogic discourse of school mathematics. Pedagogic discourse is understood broadly as theories of instruction that constitute models of transmitters, acquirers, pedagogic contexts and pedagogic competence.

The analysis is intended to illustrate ways in which pedagogic discourse is socially constructed and will highlight the production of specialised positions for students and teachers in the curriculum innovation proposals carried in the reports. In the conclusion, Chapter 8, I shall undertake a very brief discussion of a current (1996/7) curriculum document in order to highlight aspects suggested by curriculum statements in the reports. It is hoped that contrasts with the current curriculum will reveal to what extent these reports pre-figure the current curriculum and to what extent mathematics education discourse in South Africa has changed over a period of dramatic social and political changes.

Chapter 2

Literature survey of curriculum studies

2.1 Introduction

In this chapter I want to establish the empirical focus of my study in relation to associated research literature. I will review literature on aspects of curriculum development and policy analysis as they relate to my empirical focus. The primary sources for my survey were the journals *Curriculum*, *Curriculum Studies*, *Curriculum Inquiry*, *Journal of Curriculum Studies*, *Pythagoras*, *Journal of Educational Policy*, *Discourse* and *Educational Policy*. The first part of my survey was guided by a search for studies that related to aspects of curriculum reform both in general and with respect to specific subjects. Here the work by Griffiths and Howson (1974), Cooper, (1983 & 1985), Moon (1986) and Dowling and Noss (1990), which all relate to curriculum reforms with special reference to mathematics curricula, served as additional primary sources.

In terms of the organisation of the chapter, the first part will consider curriculum construction in broad terms. The focus here will be on different approaches, relating to influences and trends and to general curriculum development and reforms. I will then consider trends in mathematics curriculum development internationally and finally, mathematics curriculum development in South Africa. The purpose of this chapter is to locate the study within the field of curriculum development and will not at this time consider methodological issues. In the next chapter I will look more specifically at South Africa and at how one may analyse curriculum knowledge.

From the sample literature survey it was possible to discern a number of aspects related to understanding curriculum reform that were commonly focused but accounted for differently. These aspects may be categorised into three groups for ease of discussion. Focusing on general curriculum changes, the first category relates to

the constitution of new curricula. This deals with reasons and conditions for change, factors that influence change, agents of change and factors facilitating and constraining change. The second category relates to subject-specific curriculum development and covers aspects related to *outcomes and effects of curricula.* This includes discussion on what has changed in terms of contents and pedagogy, underlying assumptions of and effects of change. The third category is concerned with *issues of implementation*, that is, with strategies for implementing change and disseminating of the curriculum. These categories will guide the discussion of the literature below.

2.2 Constituting new curricula

Ernest (1991: 121) points out that "an important feature of education is that it is an intentional activity". He asserts that these intentions are embodied in the aims of education and that their underlying assumptions are shaped by social contexts and social influences. Hence, he argues that curriculum planning must be viewed against the backdrop of social and political contexts of education and that, aims in education is always representative of the intentions of individuals or groups of persons. Ernest's (1991) thesis is concerned with the philosophy of mathematics and mathematics education and is thus not of direct relavance to this project. However the point he makes is explored in several studies that are concerned more directly with curriculum construction and reforms. These will be discussed below in an ttempt to identify social groups and highlight ways in which they have influenced curriculum reforms in different countries. In the discussion one may distinguish between State and non-State initiatives of curriculum reforms. State influences include political and broad social and economic reforms, while non-State influences relate to universities, professional associations and public opinion.

2.2.1 Broad political, social and economic movements

Curriculum reforms have very commonly been associated with broad social, political and economic reform movements (Buckland, 1984; Popkewitz, 1987; Smith, 1990;

Ball, 1993; Pachocinski, 1993; Jansen, 1995; Mosothwane, 1995). In most of these studies curriculum changes are seen as a direct result of struggles in the social, political and economic spheres. For example, Ball (1993) ascribes the development and implementation of the National Curriculum (NC) in the UK to the rise of the "Conservative New Right". His analysis is based on the strong "cultural restorationist" sentiments, redolent of the New Right, in the National Curriculum. He cites, as examples, the reassertion of factual knowledge in the school curricula of music and history at the cost of pupils' creative engagement in both subjects. Curriculum reforms in Poland (Pachocinski, 1993) in the 1980's, it is argued, were initiated by the social solidarity movement of workers and intellectuals that led to a reorganisation of both society and schooling. Within this context schools became sites for creative and innovative activities with a strong emphasis in curricula on co-operative work between pupils, teachers and parents. Curriculum contents centred on non-academic subjects like art and small business projects.

The social transition of Namibian society is documented by Jansen (1995). He points out that curriculum reforms were one of the first and most visible areas of intervention of the newly-elected government. He argues that because the transition of the society came about through a negotiated settlement, the State "was committed to gradualism in social transition which resulted in a moderate educational and curriculum reform agenda" (Jansen, 1995: 257). In his discussion he foregrounds curriculum reforms related to language policy. He argues that the new Namibian government needed to establish its own legitimacy and break its colonial ties with South Africa. Afrikaans, in particular, was viewed as the language of the oppressor and so needed to be expunged from the school curriculum. This, he asserts, resulted in a language policy that insisted on English as the medium of instruction from Grade 4, despite the fact that Afrikaans was spoken widely as the common language in most education regions of Namibia. In other words, the strong political and social agenda of the state dictated early curriculum reforms with little consideration for other educational concerns, like language fluency and mother-tongue instruction. He makes a similar argument with respect to reforms of the junior secondary curriculum and the examination system.

Carlgren (1995) offers a perspective that suggests that it is not only political and social reforms internal to the state that spark state initiatives for curriculum change. She argues that the latest reform of the Swedish National Curriculum must be seen as part of a "'universal movement' toward restructuring the educational systems of 'western' welfare societies" (Carlgren, 1995: 411). By this she means curriculum reforms that establish the marketization of education and introduce attainment targets and standardised assessment. Within this context of "restructuring", curriculum reforms have shifted from providing guidelines and outlining processes for teaching to specifying "purposes, objectives and goals for different subjects" (ibid: 426). In other words, the reforms of the Swedish National Curriculum are less about changing contents in order to meet the demands of a changing society than about reforming the language of curricula in line with "universal" trends in educational policies.

Economic imperatives are largely cited as reasons for curriculum reforms initiated in Australia, Botswana and South Africa. For example, Smith (1990) argues that the decline of competitiveness on the international trade market of Australia's economy in the late 1980s spurred on curriculum reforms that were aimed at developing broad-based skills that could contribute to the widening and strengthening of its local economy. Buckland (1984) and Mosothwane (1995) both argue that the rise of capitalism and increasing technological advances in South Africa and Botswana respectively, resulted in curriculum reforms that were geared specifically towards the "the training of skilled manpower". The emphasis of curriculum reforms in both cases was placed on vocational training.

2.2.2 Bureaucratic institutions

State influences on curriculum construction is referred to in several studies in their discussions of activities of the educational bureaucracy. Taylor (1993) distinguishes between the functions of legislators and interpreters within the bureaucratic domain of the state, the former assuming political control, the latter, administrative control, over curriculum production[1]. In particular, he notes that:

[1] He notes that these functions are usually, but not always, closely aligned.

> The administrative regulation of knowledge [...] is effected through the bureaucracy of education departments and associated agencies, and it is in this domain of the interpretative cycle that knowledge is packaged in its explicit school curricula form (p 320).

It is not surprising therefore that several studies on curriculum reforms focus on the activities of bureaucratic institutions as agencies of change. These activities include policy formulation (Kallaway, 1984; Dowling and Noss, 1990; Unterhalte et al, 1991; Ball, 1993; Goodson, 1993; Pachochinski, 1993; Carlgren, 1995; Jansen, 1995;) and strategies for disseminating and implementing new curricula (Brown, 1990; Drake, 1990; Schuber, 1990). Most commonly, these studies are concerned with the political dimensions of curriculum reforms.

Kallaway (1984) for example, relates educational policy changes in South Africa, in the late 1970s and early 1980s, to explicit attempts on the part of the apartheid state to control and co-opt its black population so as to maintain the political and economic dominance of white South Africans. These policy reforms included greater emphasis on technical and vocational education and a restriction of access (financially) to academic education for blacks. Dowling and Noss (1990), Ball (1993) and Goodson (1993) critically examine bureaucratic influences on the formulation and implementation of the National Curriculum in the UK in the late 1980s. In particular, they point to the speed at which this was achieved (through legislation) and its massive programme of centralised assessment that ensured bureaucratic control over the curriculum reforms. Ball (1993) identifies the National Curriculum Council (NCC) and the Schools Examination and Assessment Council (SEAC) as two newly-created agencies of change, both of which were chaired by political appointments from the Conservative New Right. Proposals from these two Councils, on the setting of attainment targets, the construction of study programmes and procedures for assessment, were legislated in the form of the National Curriculum in 1991. I have already described Ball's account of what some of these reforms entailed.

It is clear that strong bureaucratic influences on curriculum reforms are associated with the construction of "national curricula" and with centralised control over

education. This is the case also with regard to the latest reforms in Sweden, as Carlgren (1995) outlines. Here, a National Curriculum Committee (NCC) and a Parliamentary Marking Committee (CMM), consisting of mainly civil servants within the Ministry of Education, were given the tasks of rewriting the National Curricula for the whole school system, making syllabus proposals and formulating criteria for grading each school subject. Syllabus proposals were meant to state only objectives and not prescriptions for teaching. While these reforms were initiated in order to decentralise control over the curriculum by giving teachers greater freedom over the implementation of this curriculum, Carlgren argues that the centralisation of assessment, through a criteria -referenced grading system, in fact limited the scope for professional decisions and actions. The result was that centralised control over curriculum reforms was maintained. Bureaucratic strategies for implementing change will be discussed in a later section.

The above studies mostly relate to broad educational and curriculum reforms and are often vague about specific content changes. Nonetheless, they highlight the influential positioning of bureaucratic institutions and the impact that state initiatives can have on curriculum reforms. They suggest also that bureaucratic control over curriculum knowledge is most often motivated by political imperatives consistent with dominant political positions in the society.

In the following sections, studies which look at subject-specific curriculum development will be discussed. While not explicitly focused on in this discussion, several of these studies foreground a historical dimension to their studies. For example, Griffiths and Howson (1974), Moon (1986), Cooper (1983) and Goodson (1983) discuss influences on curriculum construction within the context of establishing a particular history of curriculum development. Griffiths and Howson (1974) focus on history of mathematics curricula in general, Moon (1986) focuses on the development of "New Maths" in the 1960s, Cooper (1983) examines the historical development of the School Mathematics Project (SMP) curriculum and Goodson (1983) discusses the development of environmental education from a historical perspective. These studies have been selected for discussion since they illustrate an

engagement with the historical development of curricula, which is of particular interest to my study. In doing so, they highlight additional influences on curriculum reforms that suggest that curriculum construction is a complex and highly contested process reflective of much more than simply state pressures and legislation. These influences will be discussed in more detail below and will include the literature relating to mathematics curricula development internationally.

2.2.3 Pressure from universities

Universities are clearly non-state institutions through which, amongst other influences, social and political pressures work. They establish academic voices which are seemingly distinct from bureaucratic voices. School curricula are influenced by universities because of developments within academic disciplines on one hand, and developments in educational psychology on the other.

(a) Influence of academic disciplines

In his description of the formation of school subjects in America between 1880 and 1920, Popkewitz (1987) describes numerous social functions of universities that evolved around this time that had a direct impact on the formation of the school curriculum. Among these was their role in defining "what society was to value as its sacred knowledge", their responsibility "for producing productive elements related to an industrial society" and their role as "a credentialing agent for both knowledge and society" (Popkewitz, 1987: 13). He argues that "the inclusion of university categories of knowledge into schools had a consequence of legitimating both the knowledge and its "holders". By making particular occupational work a subject of schooling, an occupation is given status" (ibid: 14). Expert disciplinary knowledge was assumed to emanate from the universities and so academics could talk with authority about what knowledge should go into school curricula. In doing so, Popkewitz (1987) asserts that universities were able to define "practical and useful knowledge - to assist commerce, industry, agriculture and government" (ibid: 13) as well as "do research, plan programs and evaluate the consequences of programs for implementing political agendas" (ibid: 14).

Studies by Griffiths and Howson (1974), Cooper (1983 & 1985), Moon (1986) and Wojciechowski (1989), on the development of mathematics curricula are particularly illustrative of the influence academics have had on the shaping of school mathematics curricula[2]. For example, Griffiths and Howson (1974) refer to the phenomenal growth in pure and applied mathematics since the nineteenth century and show how these new developments were necessarily incorporated into university mathematics courses which in turn put pressure on school mathematics curricula to include new concepts and place new emphases in teaching in order to prepare students for university mathematics courses as well as new technological demands from industry. Here they refer to examples such as the introduction of set theory and the "axiomatic method" and basic notions of computing (flow charts and iteration) into school mathematics curricula in the twentieth century.

In his study of the "New Maths" curriculum controversy of the 1960s and 1970s Moon (1986) compares the responses in five European countries. In his analysis he highlights the prominence of individuals and groups of university mathematicians, often with close links to the government, in promoting curriculum reforms in the 1960s:

> [T]he evidence points overwhelmingly in each national context to the influence of university mathematicians in promoting school mathematics reform. It was a classic "top down" process. [...] The close links, often on a personal basis, between the university world and government enabled influence to be exerted both for funding and to enlist support for a range of activities. At the end of the 1950s, and in the early 1960s, even greater influence could be achieved through involvement in the international agencies (Moon 1986: 213).

Cooper's (1983 & 1985) study, on the origins and sources of the School Mathematics Project (SMP), a relatively influential curriculum intiative in the UK in the early 1960s, illustrates this point further. He shows how the views of applied mathematicians, like Dr. J.M. Hammersley[3] and Dr. B. Thwaites[4], were instrumental in the formulation and launching of the SMP curriculum initiative. Through their

[2] Goodson (1983) relates similar influences in the development of environmental education as a viable curriculum possibility.
[3] Professor at Trinity College, Oxford
[4] Professor of theoretical Mechanics, Southampton University

influences the SMP curriculum proposals included statistics, linear programming and "modelling" of physical situations through, for example, differential calculus, in addition to ideas from modern algebra[5] which they endorsed.

(b) Influence of educational psychology

Pressure from universities on curriculum reform in mathematics have however not only come from university mathematicians. Griffiths and Howson (1974) and Popkewitz (1987) point to the influence of educational research, particularly related to learning theories, on curriculum reforms. Griffiths and Howson, for example, refer to the extent to which Piaget's developmental psychology has been used as a framework for educational researchers and curriculum developers to develop new "technologies of education" that is, finding new methods for both stimulating and checking children's learning. Their argument suggests that it is on the basis of Piaget's framework that curriculum developers came to define certain knowledge as appropriate for children at different developmental stages. Popkewitz (1987: 16) refers to the dominant influence of educational psychology since the 1930s as the "psychologization of the curriculum". He asserts that the psychological basis for curriculum design is a mechanism of social control in schooling: "Educational research developed within university departments to provide management of the knowledge and of the people processed in schools" (ibid: 16). He argues that curriculum initiatives informed by educational psychology research were very often structured around the notion of "need". That is, around perceptions of what knowledge students "needed" to become productive and moral citizens:

> Psychology emphasised individual ability and social development based upon merit. The discourse responded directly to concerns about moral upbringing and labour socialisation by focusing upon the thoughts and attitudes of individuals (Popkewitz, 1987: 17).

> The notion of "need" implied dependency and defects in moral, intellectual and personal make-up of segments of the school clientele (ibid: 18).

[5] These included set theory and symbolism, groups, equivalent relationships and probability (Cooper, 1985: 239)

It is clear from the above that the influence of educational psychology concerned not only content but also pedagogies. Educational psychology provided the means for educators to define "the child" they were teaching and so created a space not only to talk about *what* "the child" should learn, but also *how* "the child" should be taught. Cooper (1985), for example, describes mainstream perspectives since the 1930s on curriculum differentiation for mathematics based on the "ability" of the child and perspectives on pedagogic reforms proposed by members of the Association of Teaching Aids In Mathematics (ATAM) in the 1950s. He argues that perspectives on differentiated curricula, cited below, employed psychological models of the child that identified distinct "types" of children and proposed that each type receives appropriately different educational offerings:

> [W]ide spread differences in ability must be met by syllabuses which differ not only in content and difficulty, but also in outlook and treatment (*Senior School Mathematics*, 1934, in Cooper, 1985: 49).

> ....geometry should be taken with all streams. The difference will be in the treatment given and the range covered. Whereas some of the work of the "A" stream can be deductive and can deal with generalisation, that of the "C" stream will be entirely practical, measurement and observation taking the place of intellectual activity (James, 1958, in Cooper, p 50).

> The secondary modern school is the school for the average and below average child, the slow learner, the "non-academic", the child with handicaps of all kinds - essentially the child who needs all the skill a resourceful teacher has at its command.
>
> For the so-called "bright" child, ability to leap from the concrete experience to generalisations and abstract ideas is the hallmark of intelligence. It is an intellectual process which demands great mental effort, and the difference between the bright, nimble-minded, intelligent child and the "dull" or "slow" or "non-academically minded" child is the difference in his ability to make this effort (Morgan, 1959, in Cooper, p 50).

Differentiating students in this way was thus used as motivation for adapting mathematics curricula to meet the "needs" of students with different "abilities". Likewise, motivation for pedagogic reforms from the ATAM members were based on psychological models of the child. Their major concern was to reform mathematics pedagogy through the increased use of teaching aids such as films and structural apparatus. Their model of the child was one of an active, creative being who constructs his/her own knowledge and who should therefore be presented with "experiences" in the classroom to allow for such active constructions. Hence the call from certain members for the use of teaching aids in the instruction of mathematics.

The discussion above highlights the positioning of university academics as agents of curriculum construction and change. As higher institutions of learning, universities are strategically placed to exert influence on the contents of school curricula. I will continue now to consider other non-state influences on curriculum construction.

2.2.4 Pressure from schools

While teachers have not been implicated in initiating many curricula reforms, they have been identified as key agents of change in the sense that they are the ones who have to reproduce and implement curriculum reforms in the classroom. Griffiths and Howson (1974) make this point clearly:

> The teacher [...] plays a vital role in curriculum development whether the educational system is centralised [...] or whether the individual school has considerable freedom [...]. In the former case, new courses can, through ignorance, or malice, be taught in a way which is directly at variance with the ideas of those who designed the curriculum; whilst in the latter case the teacher is free not only to travesty change but to reject all initiatives, either good or bad (Griffiths and Howson, 1974 62).

An illustration of teachers' attempts at implementation is provided by Hawkey (1993). She gives an account of her faculty's attempt to implement the National Curriculum in the UK with respect to History and Geography. She shows that what was achieved was not simple delivery of the National Curriculum, but a "mutation" of the curriculum that represented a compromise between what teachers valued in the teaching of Humanities and the attainment targets of the National Curriculum. This suggests that teachers are not straightforward agents or implementors of change. Brown (1990) came to a similar conclusion based on a comparative study of differences in pedagogic practice and orientations to change between schools in one district. He found that, where schools experienced strong pressure from within for curriculum change, that is, from localised conditions of practice[6], there was much resistance to "top down" change, as in the National Curriculum, since this was then perceived to be "irrelevant or impractical given prevailing conditions" (Brown, 1990:

[6] These included a preoccupation with social issues at the school related to children's attitudes to schooling and their motivation and orientations to learning. Pressure came from a need to address what they perceived to be a problematic relationship between home and school (Brown, 1990: 207).

207). In contrast, schools that did not experience any demand for change and whose practices remained fairly static, were more likely to implement the reforms of the National Curriculum. In these schools:

> The motivation for development must come from elsewhere. The provision of skills and knowledge orientated INSET seems unlikely to provide this nor does "consciousness raising" style material. It seems more likely, paradoxically, that it is solely the "authority" of the National Curriculum, acting through the authority of the headteacher and the LEA, that will facilitate its implementation (Brown, 1990: 208).

He notes that the effects of this implementation are difficult to predict. Nonetheless, his study points to the effects of the contexts in which teachers, as agents and implementors of change, work and that conditions within these contexts might act to maintain existing practices or to maintain resistance to change. In other words, the process of transformation of policies or curriculum proposals into appropriate practices, via teachers, is a contingent one and cannot always be guaranteed.

While Brown's (1990) study highlights "orientations to change" resulting from local conditions of practice as one such contingency, Cooper (1985) found that teachers supported or rejected curriculum changes in terms of the construction of careers for themselves and their pupils. His analysis shows for example, that teachers at well-resourced schools often welcomed university influences on their teaching syllabuses, partly because their pupils were well placed to successfully compete for scarce university places. On the other hand, teachers from less well-resourced schools were more often resistant to university control of syllabuses and rather welcomed influences from employers of non-graduates. It is clear from all these studies that the strategic position of teachers in the classroom allows them to act either as agents of change or agents of resistance, depending on a host of factors that relate to local conditions of practice and perceptions of what the changes mean.

2.2.5 Pressures from professional associations, alliances and conferences

In their studies of subject-specific curriculum development, Cooper (1985), Moon (1986) and Goodson (1988) illustrate the powerful influence of subject associations

and conferences, on facilitating curriculum reforms. In their studies they examine debates within subject associations and conferences to show that these are key arenas in which what counts as curriculum knowledge is negotiated and where curriculum reforms are promoted and legitimation is sought for such reforms. Cooper (1985), for example, refers to debates within the Association of Teaching Aids in Mathematics, the Mathematical Association and conferences at Oxford, Liverpool and Southampton in the late 1950s and early 1960s, as forerunners to the curriculum proposals of the SMP and the Midlands Mathematics Experiment (MME). His study tracks the participation of the initiators of these two projects in those early conferences and associations and shows how they marshalled support for their ideas through association journals, their conference papers, their invitations to teachers, university mathematicians and employers of graduates to these conferences. While their curriculum proposals were slightly different, they were reflective of the dominant debates promoted in those associations and conferences.

Goodson's (1988) study of how geography became established as an academic discipline in the 1960s also relates to the activities and influence of the Geographical Association. He argues that the promotion of "new geography" through this association was instrumental in realising the aspirations of a "low status" school subject to become an academic subject and so to raise its status as a school subject. In these studies of Cooper, Moon and Goodson, subject associations and subject-specific conferences bring into focus alliances and allegiances formed within these contexts that further contribute to the facilitation of change.

Moon (1986) describes "the power of the lobby" that promoted the "New Maths" curriculum reforms in European countries in the 1960s and 1970s. He argues that this power was derived from relationships and alliances between social groups established at various times in response to pressures internal and external to education. Here he refers to alliances of mathematics educators with administrators, institutions, publishers, subject associations, primary school teachers, university specialists, parents and industry and commerce. He relates different phases of the "New Maths" controversy in each country studied to the dominant alliances of the time that

contributed to "the power of the lobby". He refers for example to the powerful alliance between university mathematicians and primary school teachers in the UK at one stage and then, the impact of the alliance between parents and industrialists on reforms in the 1970s.

Cooper (1985) argues similarly, that the relative success of the SMP may be attributed to the powerful alliance between applied mathematicians and employers of graduates and affiliation with them by teachers from higher prestige and well-resourced schools. He points out however, that alliances and successful reforms are not only dependent on common interests but are very commonly determined by distribution and access to resources. Such resources included status, academic legitimacy and financial resources. For example, in his comparison of the SMP and the MME, he argues that the close affiliation of the SMP with universities, through their leadership, allowed them greater access to financial resources as well as being sufficiently resourced themselves to develop and publicise their work much more widely than the MME could.

The studies of the relations of conflict and co-operation between social pressure groups within mathematics and groups outside of mathematics by Cooper, Moon and Goodson, illustrate the contested nature of curriculum definition through reforms and the complexity of relationships between agents of change. It is clear that no single description of the process of constituting new curricula is sufficient. Curriculum reforms would always have to be described against a background of shifting relations of power and of broader social, political and economic changes.

2.2.6 Pressures resulting from public opinion

Based on an analysis of the revolutionary nature of curriculum reforms in mathematics in the 1900s and the 1960s, Wojciechowska (1989) asserts that public opinion was a major contributor to the failure of curriculum reforms in the past. She notes that the public's interest in school and education exerts a substantial influence not only on curriculum administrators and decision makers, but also on teachers. She suggests that public opinion exerts pressure on educators to maintain a balance

between responding to technological advances in society on one hand and ensuring cultural continuity on the other, that is, to contribute to "the survival of tradition and of everything that accounts for social and national identity" (Wojciechowska, 1989: 156). The major obstacle to particularly radical curriculum reforms as she sees it, has been the conservative nature of public opinion: "any attempts to establish in school new mathematical concepts and problems different from those that had been taught to the pupils' parents were rejected almost immediately" (ibid: 157). She argues that this was the case in the 1900s and 1960s particularly because the reforms presented a monolithic ideology of mathematics which was viewed as radically different to the traditional view at the time. Her argument thus suggests that the success or failure of curriculum reforms are dependent on the degree to which the public (parents) can identify with the changes and in her opinion, this could only happen if changes are introduced gradually and people are allowed choices with respect to their ideology of mathematics and approaches to the teaching of the subject.

To summarise, the above section has pointed to a range of state and non-state influences on curriculum construction. The literature shows that state-initiated curriculum reforms may vary, depending on whether there are centralised or decentralised systems of educational control and therefore on what measure of autonomy exists over curriculum construction. Bureaucratic institutions were positioned as influential agencies of curriculum change. The discussion of non-state influences further highlighted the positioning of academics and teachers as agents of curriculum change. In addition, professional associations and strategic alliances between different agents have also been shown to have initiated several curriculum reforms. I shall now consider studies that look at the outcomes and effects of a curriculum.

2.3 Outcomes and effects of curricula

In this section I want to look at studies that focus not on the influences of change, but on mathematical and pedagogical assumptions of curricula reforms and their effects. I have selected in particular, to discuss papers that look critically at mathematics within

the National Curriculum in the UK, since the HSRC research reports specifically index curriculum developments in England and other European countries.

2.3.1 Differentiating students: assessment and pedagogy

Noss (1990) takes issue with the tension between the utilitarian view of mathematics in the curriculum as "a set of tools which can be applied to the solution of (industrial or economic) problems" and the view that mathematics is "a means of making sense of the world, a way of thinking which offers a medium to express generality and pattern" (Noss, 1990: 17). He shows that the kinds of "practical problems"[7] which are meant to illustrate the mathematics to be used in later life, are concerned with nothing more than the "solution of artificial mini-stories full of spurious contextual matter but devoid of meaning" (ibid: 19). Noss (1990) asserts that the proliferation of these types of problems in the National Curriculum and the way they are meant to be assessed suggests that:

> Even where there is an expressed need on the part of industry for educationally positive curricula change, the priorities lie elsewhere - in the logic of the assessment process itself, and more generally in the political and social realm rather than the directly economic (ibid: 23).

In other words, despite its claim of promoting the use value of mathematics, the National Curriculum is ultimately only concerned with producing an effective mechanism of social control through a rigid system of assessment that "grades and compares children, teachers and schools" (Noss, 1990: 23).

Goldstein (1990) looks more closely at the system of assessment and intentions to use it to compare school results. He argues that the criterion referenced national assessment system necessarily operates at a level of generality that demands "a set of "context free" descriptions" (Goldstein, 1990: 68). He gives as an example an attainment target that reads: "Select materials and the mathematics to use for a practical task" (ibid: 68). He asserts that to "make a decontextualised statement of

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[7] One of the examples he refers to is the following (Noss, 1990: 18):
If British Airways runs flights between each of 8 major airports in Europe, how many routes is that? What happens for a different number of airports?

achievement on such a base requires major assumptions" (ibid: 69), since such an attainment target could be applied in any number of teaching or learning contexts. He thus criticises the comparison of school results within this system since they do not take into account differences in teaching and learning contexts.[8] In particular, he notes that national assessment of this form "ignores the single most important factor influencing achievement during schooling, namely the achievement of the pupils at time of entry to school" (Goldstein, 1990: 71). In other words, high performance rates of schools might be less about effective teaching and related more to already high achieving pupils. His central point, however, is the evidence that suggests that "to use assessment results to compare schools promotes wasteful and unfair competition" (ibid: 72). It is a system that sets schools up to "teach to the test", concentrating on achieving high test scores at the expense of achieving quality education for their pupils.

The effect on teachers of an assessment-driven curriculum like the National Curriculum, is described by Carter and Burgess (1993). They claim that "more explicit control of pupil assessment is a prescriptive positioning of teachers; the need to administer tests compels teachers to organise and manage classrooms in particular ways (Carter and Burgess, 1990: 236). In other words, the quality of assessment becomes dependent on classroom management and organisation. So, while the attainment targets do not appear to be pedagogic prescriptions, they do influence classroom practice. They refer for example, to primary school teachers accustomed to more intuitive methods of assessment, who were compelled within the new system to devise more technical procedures for monitoring and assessing pupils.

In his analysis of how the "attainment targets" of the National Curriculum differentiates students, Dowling (1990) points to its assumption that performances "are produced by underlying competencies which may develop, but only at a rate determined by some combination of the essential qualities "age" and "ability" [of pupils]" (Dowling, 1990: 54). He adds "maturity" as another criterion upon which students are differentiated, where "maturity" is seen as a function of "ability" and

[8] These might include distribution of resources, pedagogic styles and language competencies.

"age" such that "immature" is applied to *either* low "ability" or low "age" (inclusive "or")" (ibid: 55, emphasis in original). He illustrates, through an analysis of texts produced for different levels of students, that different strategies or pedagogies are used to teach these pupils. He refers for example, to the differences in chapter titles and tasks between texts produced for the "highest attainers" (the "yellow" series) and those produced for the "below average attainers" (the "green" series):

> The chapter titles of the "yellow" series are simple and descriptive of the content - "Negative Numbers and Equations" - tasks very often include additional non-mathematical knowledge (information concerning the period and frequency of the vibrations of a fly's wing, for example), and references to school generally relate to the content of the lessons - frequently science. The chapter titles of the "green" books include some more sensationalist headings - "Cheapo rulers", "Detective Dice" - as well as the more mundane entries, many of the tasks include non-mathematical information which can hardly be referred to as "informative", since it is clearly invented and fictitious (sometimes bizarre: "Angel fish sleep nose down"), and references to school generally relate to organisation rather than content (the school timetable, for example) (Dowling, 1990: 55).

Dowling sees the attribution of essential qualities to students as a strategy to both "define the limits of curricula effectiveness" and to place "the blame for failure onto the student her/himself" (ibid: 59). He notes for example, that the mundane curriculum for the "less able" students "simply offers them new and complicated solutions to problems that they can already solve far more simply" (ibid: 59). Furthermore, he notes that, through the concept of utilitarianism, pedagogic differentiation facilitates differences in an even more direct way:

> If it is the case, for example, that students assessed as having low "ability" are directed towards a more mundane curriculum, concentrating on "everyday" activities such as the use of money, or the school-timetable, whilst students assessed as having high "ability" engage in a form of curriculum which is forever introducing more exotic ideas, then we might expect a difference in respective "success", and certainly in respective motivation (Dowling, 1990: 57).

Dowling's analysis points to a crucial aspect of curriculum construction, namely, that assumptions of assessment criteria, together with pedagogic practices that differentiate students, always result in academic outcomes that are socially constructed.

2.3.2 Sequencing of contents

Criticism of the single hierarchy of mathematics proposed through the "statements of attainment" in the National Curriculum for all children, is presented by O'Reilly (1990), Hoyles (1990) and Küchemann (1990). O'Reilly asserts that it represents a particular model of mathematics and of how children learn and that there is no basis for assuming this single hierarchy or pathway through mathematics. Hoyles stresses that "*empirical* hierarchies are not necessarily *cognitive* hierarchies, or indeed learning hierarchies" (Hoyles, 1990: 118, emphasis in original). Küchemann (1990) illustrates this point in his analysis of the attainment targets (AT) and statements of attainment for ratio in the National Curriculum. He argues for example, that there is no mathematical or pedagogic reason why the attainment target "calculate with fractions" (AT3.8)[9] should come two levels *after* the attainment target "calculate using ratios in a variety of situations" (AT3.6)[10]:

> It would be a simple matter to devise tasks fitting AT3.6 that are substantially harder than tasks fitting AT3.8. [...] [P]upils who are working at one level are bound to run into ideas that have been placed at other levels. It is absurd to suggest that at a certain age pupils should apply ratio to recipes but not to strips of wood till four years later (Küchemann, 1990: 109).

He asserts that the only criteria for the ordering of these attainment targets is "to produce a curriculum that is uniform within and between schools" (ibid: 109). In other words, it is simply a mechanism of control. O'Reilly makes a similar point, that there is not any one logical pathway through the mathematics curriculum, but many possible routes and that "different hierarchies may evolve in response to different conditions e.g. the adoption of a particular teaching scheme, or the advent of new technology, e.g. graphical calculators" (O'Reilly, 1990: 78). He concludes that a fixed hierarchy, as in the National Curriculum, effectively controls the curriculum and may result in what he terms the "ossification of mathematics teaching" for many years.

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[9] The accompanying example is: *Divide a 3m strip of wood into two parts in a given ratio* (Küchemann, 1990: 107, italics in original).

[10] The example give here is: *Adapt a recipe for 6 people to one for 8 people; enlarge a design in a given ratio* (ibid: 107, italics in original).

The studies in this section have highlighted numerous aspects of what might be considered the "message" of a curriculum. That is, aspects related to what is said, how it is said, why it is said and what is not being said. They begin to raise issues around the social functions of curricula effected through the selection and organisation of contents, pedagogic prescriptions, assessment procedures and the silences. These social functions include defining knowledge and differentiating knowledge, students, teachers and schools.

2.4 Issues of implementation

Brown (1990) problematises the issue of implementation of the National Curriculum, that is, the way that curriculum policies are to be translated into practice. In particular, he looks critically at the strategies of government support for implementation of the National Curriculum. These include: supporting INSET, providing suitable materials; permitting school days off for whole staff training and revising guidelines for PRESET courses to include specific preparation for teaching the National Curriculum. He concludes that these strategies assume that "there exists a skill and knowledge deficit on the part of teachers which can be addressed through INSET and other forms of specialist support" (Brown, 1990: 199). Furthermore, they assume that educational change is a technical problem:

> that once policies are formed and a motive for change established [...] all that needs to be done is for practitioners to be armed with appropriate techniques and knowledge and the planned change will take place (ibid: 199).

Within such a conception it is clear that teachers are positioned as key agents of implementation; that is, they are crucial for the translation of policies into practice. Brown (1990) adds that teachers here are also positioned as the "prime source of "causes" in the event of crisis", so that:

> Failure of implementation can thus be located at the level of the individual teacher, that is at the furthest possible distance from the Government itself (Brown, 1990: 200).

In other words, he argues that government strategies for supporting implementation are also mechanisms for shifting blame and responsibility, in the event of failure, from the government to the classroom teacher. There can be little doubt that government would take the credit for successful implementation (that is, *there* INSET worked). Based on an earlier study he conducted (Brown, 1985), Brown notes further that large scale implementation of pedagogic or curriculum change has to take seriously the complexity of factors that give rise to, maintain and develop classroom practice. He shows that these factors mitigate against any notion that change at the level of classroom practice is straightforward.

In the next section I shall consider studies on mathematics curriculum development in South Africa.

2.5 Mathematics curriculum development in South Africa

There are few studies on mathematics curriculum development in SA. The literature consists mainly of journal articles that are brief responses to new syllabuses and make proposals for alternative mathematics curricula. I will draw on these to discuss the process of curriculum production in SA, changes that have occurred, influences and trends in new curricula, some critiques of assumptions and effects of curricula and proposals for alternative curricula. The discussion serves in some way as a background to my own study.

2.5.1 Curriculum production

Julie (1991/92) outlines the process of mathematics curriculum production in the past, within the context of multiple racially-determined education departments in SA:

> The mathematics curriculum process starts with an initial draft curriculum being drawn up by a group of experts decided upon by a para-statal board or syllabus revision committee. This syllabus revision committee is almost always chosen from the white departments. The draft syllabus[11] this committee constructs, is distributed to the different education departments, mathematics departments of universities and acknowledged (that is, state-approved) school mathematics

[11] The syllabus includes descriptions of goals and aims, contents, assessment procedures and comments on methodology.

> associations for comments. The various departments set up mathematics syllabus committees whose brief is to review the draft and make recommendations. After further reviews and recommendations, the board and/or committee of experts will avail all departments of a syllabus which is now known as the core syllabus. Its function is to guide departmental syllabus committees in the construction of their syllabi. The core syllabus is described as the minimal set of mathematics that is to be covered within a given school year and it must thus be a subset of the content of the syllabi of all the departments. Minor additions to the syllabus are viewed by the state as "accommodating the needs of the different cultures". In reality, however, the syllabus that eventually reaches teachers is the same syllabus for different races - with state ideology built in via the core syllabus (Julie, 1991/2: 4).

Except for the school mathematics associations, of which there were not many at that time and which were mainly drawn from white schools, teachers are notably absent from the process of production. It is also clear that there was tight state control over the production of curricula. With respect to implementation, Julie describes the process as follows:

> During this phase, syllabus interpretation is done for mathematics teachers by school inspectors and subject advisers who, like teachers are employed by the state. These inspectors and subject advisers play prominent roles in the syllabus committees previously mentioned. Syllabus interpretation is sometimes carried to the point where detailed workplans, frequently describing what teachers must do during each mathematics period, are designed for teachers. They are expected to follow these workplans slavishly. Frequent inspections on whether teachers are executing the workplans in accordance with the goals - which in most cases are the improvement of examination achievement results - set out by the administrators are carried out by the same interpreters.
> Covert interpreters of the intended curriculum are authors of textbooks and designers of curriculum materials. These persons are in many cases the same as those closely involved in the initial design of the core syllabus and/or persons serving on curriculum materials selection panels - persons selected by the education departments to evaluate and approve curriculum materials to be issued free to schools (Julie, 1991/2: 5).

In other words, a feature of curriculum production in South Africa in the past has been the dominance of bureaucratic control of the product and process and the positioning of teachers as mere technicians to implement prescribed syllabuses. Julie (1992) points to another feature of the implementation process and that is, its staggered introduction into schools of different racial departments. The process usually entailed implementing syllabuses in white schools first, making some amendments and then introducing it into schools from other racial departments. For Julie (1990), the process of production and implementation signals "the fundamental role that conception and interpretation play in curriculum as an agency of discrimination" (Julie, 1990: 5). While he poses a number of questions related to the "ideological intent of mathematics education" like, "Who conceived the curriculum and in whose

interests was it conceived? Who were the participants in the design process? Who interprets the curriculum?" (ibid: 5)[12], and later offers some strategies of resistance to the existing curriculum, Julie himself does not unpack the ideological intent of mathematics curricula in South Africa. To be fair, he does allude to "state ideology" and its discrimination policies, and the interests of "the ruling class" being served by the curriculum, but there is no analysis of exactly how the mathematics curriculum furthers discrimination policies or other interests of the ruling class.

Laridon (1990) describes the process of curriculum development in SA in the past as "syllabus tinkering". He argues that "curriculum development" here has amounted to essentially superficial content changes[13]:

> Topics are put in or pulled out of the syllabus either to follow international trends or on the basis of data gathered from ill-timed questionnaires directed at relatively small and non-representative samples of respondents (Laridon, 1990: 21).

He gives as examples syllabus reforms of the mid-seventies which responded to the "new maths" movement in Europe:

> Mathematical structure was the "*in thing*" [...] so in had to come sets and groups and axiomatisation and vectors and all that. So out had to go calculus and analytical geometry to prevent overloading (Laridon, 1990: 21, emphasis in original).

Due to teachers' ill-preparedness for these "new" topics:

> [W]ithin a year (or was it two), groups and fields were dumped. Questionnaires went the rounds soon after, canvassing the opinions of largely tertiary lecturers with a few bewildered (at that stage) teachers included. As a result out went vectors and back came analytical geometry and calculus (1983 Core Syllabus), linear programming being introduced as a trendy topic (Laridon, 1990: 21).

Before any examinations were written on the 1983 syllabus:

> [A]gain opinions were sought, so out goes linear programming (to an optional module) and back comes vectors (presumably because the limited sample of teachers canvassed recently, are finding

[12] Adler (1992) raises similar questions in her analysis of the 1991 draft core syllabus for mathematics for senior primary.

[13] Adler (1992) illustrates "syllabus tinkering" through content changes like the introduction of decimal fractions in Std. 2 and fraction concept explored in Stds. 2 & 3 and representation of fractions on a numberline in Std. 4 and so on.

the former difficult to teach right now while the latter, after some years of experience, was found to be quite agreeable) (Laridon, 1990: 21).

Laridon's brief description of syllabus changes renders the question of how the mathematics curriculum furthers the discriminatory policies of the state, even more elusive. He too refers to the "top-down" approach to curriculum development outlined by Julie (1991/2), describing it as development "from first to third world" and as a process that "ignores the needs of the majority (+/- 90%) of pupils in the country" (Julie 1991/2: 22). He suggests that these "needs" are not met by current syllabuses which are "academic in their orientation" and comments further that "the only honest way of going about curriculum development would be from third to first world" (ibid: 22). While he implies that this means a "bottom-up" strategy of curriculum development, one wonders how and by whom "third world needs" will be interpreted and how such a strategy will challenge what Laridon (1990) and Julie (1991/2) recognise as the hegemony of state ideology in the current curriculum.

It is clear from the descriptions of the curriculum development process and the critiques offered here, that curriculum production within the South African context is necessarily viewed as a political issue. As Adler (1992) states, the educational context in SA in the 1990s is one "where the crisis is as much about legitimacy as at is about provision and change" (Adler, 1992: 26). This is supported by the analyses of syllabuses and the literature on alternative proposals for curricula which will be discussed later. Before that I want to discuss changes that have been made and the influences and trends on curriculum change in SA.

2.5.2 Curriculum changes

As already stated by Laridon (1990) above, curriculum changes in SA in the past may be closely linked to international trends and developments in mathematics education, most notably in the USA and the UK. He mentioned the emergence of the "new maths" movement in Europe as one such trend that influenced particularly content

changes in the junior and senior secondary South African mathematics curricula[14]. During this period (from 1974-1984) there were at least five new syllabuses that were introduced at each level that reflected content changes[15].

Laridon (1993) and others (Adler, 1992; Julie, 1993; Volmink, 1993) point to the influence of "technological developments" and "constructivism" on subsequent mathematics curriculum changes in SA, particularly with respect to pedagogies. These changes are reflected in new syllabuses between 1988 and 1991, in white departments at all levels.

Adler (1992) and Laridon (1993) argue for example, that the influence of technological developments can be seen by the introduction of the calculator, as "both a computational tool as well as a tool for mathematical inquiry" (Adler, 1992: p 28), into the 1991 draft core syllabus for senior primary. Its effects on the syllabus and teaching, according to Adler (1992: 27) is that "narrow limits on number development have been removed" and pedagogic emphasis has shifted from "mastery of standard algorithm"[16] to developing estimation skills and the "development of algorithmic thinking"[17]. Laridon (1993: 41) suggests that the introduction of the calculator "is meaningful in a country which aspires to break out of its third world bonds". For both Adler and Laridon, it seems that the change in the curriculum, to include calculator work, is viewed positively from a pedagogic perspective. However, they both suggest that the syllabus as it stands, with pedagogic prescriptions related to calculator use, will disadvantage a large proportion of the population who do not have ready access to calculators.

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[14] These encompassed the inclusion and exclusion at various times of sets, vectors, groups and fields, calculus, analytical geometry, linear algebra, statistics and probability to name a few (from Laridon, 1990 and Cameron, 1997).

[15] Mike Cameron (1997), Senior Subject Advisor, Department of Education, Training and Culture, personal communication. He adds that the task of dating these changes is difficult because they were introduced at different times for schools from different education departments, although, as Julie (1991/2) recounted, he acknowledges that new syllabuses from "other" departments merely implemented changes that were proposed and introduced by the white education department.

[16] From preamble to 1978/1983 Department of Education and Training (DET) syllabus document (in Adler 1992: 28).

[17] From principles of 1991 draft core syllabus document, Department of Education and Culture (DEC) (in Adler, 1992: 28).

The impact of "constructivism"[18] on curriculum changes is discussed in Adler (1992), Laridon (1993) and Volmink (1993). As evidence of constructivist influences, Adler (1992) quotes from the principles of the 1991 draft core syllabus[19]:

> The pupil learning mathematics is conceptualised an active mathematical thinker who tries construct (sic - JG) meaning of what he (sic - JA) is doing on the basis of personal experience and who is developing his way of thinking as his experience broadens, always building on the knowledge which he has already constructed (DEC, 1991:1, in Adler, 1992: 29)
>
> In implementing the Mathematics Curriculum, due attention should be given...also to the mathematical processes by means of which pupils are actively and productively involved in learning, e.g. comparing, classifying, describing, representing, pattern searching, inferring, analysing, proving and problem-solving (DEC, 1991:1, ibid)
>
> Problem solving should be the central focus of teaching and learning mathematics. Not only is the ability to solve problems a major reason for studying mathematics, but problem solving provides a context for learning and doing mathematics (DEC, 1991:1, in Adler, 1992: 27).

She argues that this shift in emphasis from children as passive learners, who have to master skills and understand concepts, to children as active participants making meaning of mathematics, with problem-solving as a central focus, represents the most significant change from syllabuses of the 1970s and late 1980s. In other words, she argues that it represents much more than "syllabus tinkering", observing that references to "neatness", "accuracy", "training habits" and "systematic methods of working" are noticeably absent in the new draft syllabus. For Volmink (1993) these principles represent a shift away from authoritarian and algorithmic teaching to a more exploratory approach. The role of the teacher shifts from regulator/authority to teacher as facilitator/equal (Parker, 1995).

The pedagogic implications of a constructivist paradigm, it is argued, lie in the emphasis on "communication" and "dialogue" between learners and between learners

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[18] Understood here to mean "a theory about how we construct our knowledge as active participants rather than receive knowledge as passive recipients" (Volmink, 1993: 33). Davis (1995: 23, footnote) notes that "the constructivist position is marked by differently named "approaches" in the field: the "constructivist approach", the "new maths", the "investigative approach", the "problem-centred approach" and often by "approaches" which are categorised as "learner-centred"".

[19] At a technical level, Adler (1992) notes that the inclusion of "principles" in the syllabus document as well as examples and comments alongside topic areas represents a new format for syllabus documents in SA.

and teachers. Adler (1992) notes for example, that the emphasis on individual meaning-making "means the teacher has to hear different meanings different children make and set them in conversation with each other" (Adler, 1992: 30). Laridon (1993) states further, that "constructivism, in the early stages of learning mathematics particularly, relies heavily on efficient communication between learners on the one hand and between learners and their teacher on the other" (Laridon, 1993: 42). Davis (1995) describes this "constructivist" paradigm as an introduction of "new forms of regulation" in which "teachers become facilitators, knowledge is to be constructed by active students who are to become self-disciplined rather than have discipline imposed on them" (Davis, 1995: 27). In addition, he argues that "new pedagogic mechanisms are to facilitate this transformation from the "bad" to the "good" :

> [F]or example, an embedding of mathematical contents in tasks which reference the everyday and the non-mathematical; the encouragement of student discussion and exploration of contents through the use of group work rather than teacher exposition; and the encouragement of student-generated rather than teacher-prescribed solution procedures (Davis, 1995: 27).

Volmink (1990) and Adler (1992) point out that "constructivist" sentiments can be found in curriculum documents of the eighties in the USA[20] and the UK[21]. The influence of constructivism on curriculum changes is thus also seen as efforts to keep up with international trends in mathematics education. More directly, the influence of constructivism on South African mathematics curricula is also ascribed to the work of researchers at Stellenbosch University. Parker (1995: 2) asserts that the work of The Research Unit for Mathematics Education (RUMEUS)[22] at Stellenbosch University, "forms the theoretical and empirical basis for the DEC (HOA)[23] innovation". Here she is referring to new syllabuses introduced in 1990/1 with its strong emphasis on "problem-centred" learning.

While the arguments above suggest that "constructivist" paradigms mark the first significant pedagogic shifts in mathematics curricula in SA, Laridon (1990) also

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[20] Volmink refers to the Curriculum and Evaluation Standards for School Mathematics document, published by the National Council for Teacher of Mathematics (NCTM).
[21] Adler refers to the Cockcroft Report of 1982.
[22] This unit conducted research and wrote textbooks for what they called "the problem-centred approach".
[23] That is, the white Department of Education and Culture.

points to attempts in South African curricula to respond to the "mathematics for all" movement[24], prevalent in curriculum developments of the eighties internationally. Firstly, he refers to the "nested style" of differentiating mathematics curricula into "Higher Grade (HG)", "Standard Grade" (SG), "Lower Grade" (LG) and "Functional Mathematics", the latter offered in standards 8-10[25]. He argues that this style of differentiating privileged academic mathematics met the needs of "0% (corrected to the nearest whole number) of our population" (Laridon, 1990: 22). He asserts, that what is not provided is "the mathematics that our peoples (sic-JG) require for living and for an appreciation of their society and culture" (ibid: 22). Secondly, he quotes from the introduction of the 1989 core syllabus (second draft) for senior secondary:

> Mathematics has an important place in the school curriculum because it (a) is an essential element of communication in the modern society; (b) has a utilitarian value, making it essential for every citizen to be sufficiently numerate to cope with the everyday mathematics of number, measurement and space; (c) has a cultural value in that it provides a broader insight into the patterns and relationships in the natural man-made world (DEC, 1989:1, in Laridon, 1990: 21, emphasis by PL).

These aims, he believes, are consistent with those expressed by the "mathematics for all" movement, particularly in the UK, in their attempts to incorporate notions of "multiculturalism" into the teaching of mathematics. It could be argued that these sentiments also influenced changes that were made to "the context of the applications of mathematics as embedded in word problems" (Julie, 1990: 3) or, what Davis (1995: 27)) refers to as "the embedding of mathematical contents in tasks which reference the everyday". These contexts aimed to be more "relevant" to the lives of pupils (See Julie, 1991 and Breen, 1991).

To summarise, mathematics curriculum changes between 1974 and 1984 constituted primarily content changes, but also introduced differentiated curricula in the form of HG, SG and LG. New syllabuses of 1988/89 and 1990/1 (for whites) introduced fundamental (Adler, 1992) pedagogic shifts in the teaching and learning of mathematics, shifted contents around, introduced new contexts for word problems, but

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[24] This is understood as a movement to "construct a curriculum that will be able to provide for the mathematical needs of all pupils. [...] It at times is seen in the context of ethnomathematics and multiculturalism in mathematics" (Laridon, 1990: 20).

[25] This was first introduced in 1975/76 (Cameron 1977, personal communication).

made no substantial changes and ostensibly slotted into the existing system of differentiated curricula. As Adler (1992) notes, these new syllabuses emerged from a racially-exclusive education department at a time when:

> Forums both within and outside of state education are debating the future shape of education and related curricula, reflecting that a new non-racial constitution is imminent, as is a single education ministry (Adler, 1992: 26).

It is interesting therefore, that after the advent of the first democratic general elections in the country and the institution of a single education ministry, that these 1989/91 syllabuses, left relatively unchanged, were introduced as "Draft National Core Syllabuses" in 1995, for implementation in 1996[26]. Provincial education departments were then given the task to produce provincial syllabuses based on the core syllabus. At this level the process was meant to include wide consultation with all relevant stakeholders identified as, universities, teachers, teacher unions, and NGEOs[27]. At one such meeting in the Western Cape in 1995, Davis (1995) recounts the participation of RUMEUS researchers, who Parker (1995) earlier stated had been influential in the formation of the 1990/1 syllabuses:

> Throughout the workshop Alwyn Olivier and Hanlie Murray of RUMEUS were constantly asked to evaluate the arguments of participants. A department official even went as far as explicitly aligning the official curriculum with the "approach" [of RUMEUS - JG] after which she thanked Olivier and Murray for their work. [...] In the official documentation, produced by the department and handed out to participants, one finds, presumably for decorative purposes, the reproduction of cartoon characters which populate the textbooks written by Olivier *et al* (Davis, 1995: 26).

It seems then, despite dramatic changes in the bureaucracy and restructuring of the education system, the "players" remained the same. In terms of the process of curriculum production and implementation as outlined by Julie (1991/2), we see that very little had changed - everybody was intended to follow a core syllabus in 1996 that whites have been following since 1991 and for which textbooks had already been produced. Once again, it raises the questions posed by Julie (1990) and Adler (1992) around the ideological intent of the curriculum - whose voices are heard, what and whose interests are served? Add to that the question: is the curriculum an agency of

[26] Cameron (1997), personal communication.
[27] This is based on my own involvement in the process from an NGEO perspective.

discrimination and if so, what is the nature of discrimination and how does it achieve this? I shall consider now more closely what critiques have been offered of mathematics curricula in SA.

2.5.3 Critiques

As some of the comments above illustrate, critiques of existing curricula and the search for alternatives, have been premised on "the assumption that mathematics education as currently practised serves the interests of the dominant groups in society" (Taylor, 1991/2: 69). To a large extent this assumption is based on the processes of curriculum production and implementation, where white education departments have taken the lead and "other" departments have merely followed their syllabuses. However, some criticisms do point to their contents as serving the interests of dominant groups. Examples already mentioned are Laridon's (1990) and Adler's (1992) comments on the introduction of calculators as being insensitive to the under-resourced conditions in a large proportion of schools that would eventually implement the curriculum under discussion. Also, Laridon (1990) comments that the academic orientation of the curriculum serves the interests of a minority of the population. Jarvis (1989) makes a similar criticism of the old (prior to 1990) curricula. With respect to pedagogy, a number of criticisms which have been levelled at the "constructivist" paradigm that underlies the 1990 curricula[28], also suggest that such a pedagogy, as outlined in the curriculum, is indicative of a particular group's interest.

For example, Volmink (1993) refers to the classroom context suggested by a "constructivist" paradigm:

> [W]e need to remind ourselves, that, the modern view of constructivism emerged out of a context where there are small, well-resourced classrooms. In South Africa, for example, large classes will be the norm rather than the exception (Volmink, 1993: 34).

He thus questions the "appropriateness" and "effectiveness" of such a paradigm within the South African context. Adler (1992) and Laridon (1993) point out

[28] I am aware of the vast literature that looks critically at constructivism as an epistemology and its working in the classroom. The scope of my study does not allow for such a discussion at this time.

assumptions related to language of instruction inherent in the pedagogic prescriptions of the document. Referring to the draft core syllabus for Standard 2-4, Adler (1992) asks:

> What does dialogue entail for children in a classroom where the language of instruction switches during this phase to English? How does the Std. 3-4 syllabus in particular absorb and deal with the situation that faces these children and their teachers - a situation that demands that they learn mathematics in English and learn English at the same time? Can this syllabus with its intended language interaction enhance the situation? Or might it be obstructive? (Adler, 1992: 31).

Her questions are posed as a criticism to a document that does not problematise language of instruction at all. She suggests that this is so precisely because the document speaks only to a section of the population - those who do not have to switch mediums of instruction[29]. She makes a similar argument regarding the absence of any references to the "social context of learning" in the document. Laridon's (1993) criticism is directed at the culture of questioning inherent in a "constructivist" paradigm. He asks:

> Can constructivism, which requires the learner to question and to develop meaning with the teacher, succeed for cultures in which such questioning is taboo? (Laridon, 1993: 42).

While he does not qualify what these cultures might be or on what basis he makes this assertion, Laridon here seems to be assuming that "constructivism" is not at variance with "white culture", but may be so with "non-white cultures". Furthermore, one may assume that Laridon's reference to "cultures" refers to practices in the home rather than the school, since prior to the new syllabuses, asking questions was "taboo" in all mathematics classes. So, one is left to wonder what assumptions Laridon himself carries about "cultural practices" of "non-whites" and what pedagogies he would suggest that would be consistent with these "cultures". The same question pertains to his suggestion for curriculum development "from third to first world" (Laridon, 1990: 22).

On a more general level, Adler (1992: 26, emphasis in original) criticises the syllabus document for its sexist language: "all children learning mathematics appear to be

[29] This would be true for English and Afrikaans first language speakers (a minority of South Africans)

"*he*"". One can draw one's own conclusions about whose interests this serves. Further criticisms of syllabus documents focus more on issues around implementation that is, how the "principles" are to be translated into practice, than specifically focusing on whose interests are being served. Laridon (1990) for example, points to the relatively unchanged contents of the senior secondary syllabuses, despite the emphasis in the preambles and principles on "activity based learning", "problem-solving" and "open-ended investigations". In other words, he argues that these principles have not been carried through in its elaboration of contents. He makes a similar argument with regard to principles for assessment, where no provision or guidelines are offered for how these type of problems are to be assessed. He refers particularly to the matric examination[30], where little has changed to reflect the new approaches to teaching. Teaching *time* is also identified as an obstacle to implementation:

> The overall time allocation for mathematics is also constrained. Implementation practices involving dialogue thus require changes in context as well as a reorganisation of the school-timetable, not to mention the relationship between time available for mathematics and the amount of mathematical content (Adler, 1992: 30).

There is an assumption by both Adler (1992) and Laridon (1990) that the emphasis on "activity based learning" and "problem-solving" will necessarily take more time and they argue that the syllabus documents do not take heed of this, since the contents have remained relatively "loaded". However, the greatest concern around implementation focuses on teacher preparedness for the new "orientation" to teaching:

> In reality there is a vast chasm between current dominant teaching practices and those implied by the draft syllabus described above. And here we are discussing teachers who are or have been trained! We know only too well that there are large numbers of underqualified teachers who cope valiantly in under-resourced schools and inevitably rely on their own authoritarian and transmission-type learning experiences to inform their teaching (Adler 1992: 30).

> Yet another related and serious problem is that activity based, investigatory/discovery methods are extremely difficult to implement successfully in the classroom[31]. Most current practising teachers avoid such methods, resorting to whole class chalk and talk teaching due to overloading of the syllabus and other pressures (Laridon, 1990: 23).

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[30] This is the final school examination written in Std.10, which is externally examined and which "drives much of the teaching that happens in schools" (Laridon, 1990: 23).

[31] Besides time constraints, no other qualification is given for this statement.

Both Adler (1992) and Laridon (1990 & 1993) thus argue that without a well organised and thought-through national programme of INSET to support these syllabuses, the syllabuses are doomed to failure. Such an INSET programme, according to Adler (1992: 30) would have to be "a process of both skilling and reskilling".

The critiques and analyses of syllabuses discussed above highlight some aspects of how curriculum documents in SA perpetuate and produce social inequalities. In particular, their origins in white education departments are equated with the service of the minority group's interest. Consequently, critiques have centred, rather superficially, around what the "conditions' and "needs" are, of those excluded from this minority group, that are not being addressed. Briefly, these "needs" and "conditions" have been identified as access to resources (financial and otherwise), material conditions, multilingualism, relevance of mathematics to *their* daily lives (non-academic mathematics) and teacher training.

A brief look at what alternatives to the existing curricula have been offered underscore this point. Breen (1986) and Julie (1991 & 1991/2) suggest "alternative worksheets" wherein "syllabus content is appropriated and reinterpreted in terms of the reality of the students and the aspirations of the people in their quest for liberation" (Julie, 1991/2: 6). These suggestions were made under the rubric of "People's Education for People's Power" - a rallying call in the mid-eighties of the National Education Crisis Committee (NECC)[32]. The worksheets are characterised by contexts and discussion questions that relate to the political, social and economic realities of an apartheid state. "Social awareness" and "political conscientising" are foregrounded, with a clear sense that mathematical objectives are secondary.

Kibi (1993: 65) proposes "mathematics clubs" as an alternative strategy that may serve as a "base against apathy and political subordination". He suggests that such clubs could become forums for democratic practices, involving communities, teachers and students and where students could be encouraged to read widely, beyond syllabus

[32] For a historical development of this movement, see Meerkotter (1993).

requirements. He asserts that activities of the club would result in "heightened participation in the classroom" and that students "will learn not to parrot, as their own, the opinions of their teachers" (ibid: 64).

Volmink (1993) proposes a curriculum based on "situated problems". By this he means problems related to "the lived experience of students" (Volmink, 1993: 37). His proposal does not seem all that different to the "problem-centred approach" already dominant in the syllabuses of 1990/1. Adler (1994: 1) proposes a curriculum that "does not advocate a single uniform pedagogical practice for all classes in all contexts". Rather, she calls for one that encourages the use of a range of pedagogic approaches so as to accommodate differences, particularly with respect to language and material conditions, in classroom contexts. We see then, that most of the alternatives offered, are guided by a sense of what is "needed" to "liberate" the oppressed and disadvantaged sections of the South African population from the shackles of apartheid education. It incorporates a search for "alternatives" that would serve the "interests" of more than just the dominant minority group in the country.

Notwithstanding this, we also note that there are no socio-historical studies such as those of Cooper (1983 & 1985), Moon (1986), Popkewitz (1987) or Goodson (1983 & 1988), who analyse curriculum change in terms of relations of power between groups, within and outside of, mathematics education. There are few references to forces that initiated change within the country. That is, besides the fact that bureaucrats from the white departments introduced new syllabuses first and the fact that these changes were influenced by developments internationally; how else were new ideas popularised and by whom; what was the relationship between bureaucrats and other sectors of the mathematics education community; how were international developments recontextualised into a racially segregated system such that such a system could be maintained; what were the differences, if any, between curricula for whites and for blacks; how is it that curricula, produced within a segregated system, could still be dominant within a restructured, non-racial education system? These are some questions that remain relatively unanswered.

There are also no sociological studies in SA such as those of Dowling (1990), Dowling and Noss (1990), Brown (1990) and Ball (1993) that look at curriculum change from the perspective of the social functions of curriculum, in particular, looking at what knowledge is privileged and for what purpose; how students are differentiated and how knowledge is distributed to them; how students and teachers are positioned within the curriculum; what are the social relations, between students and between teacher and students, that are privileged? Again, these are some questions that have only been superficially answered.

2.6 Conclusion

The background sketched above of the curriculum production process in South Africa highlights a process dominated by white bureaucrats. It entailed predominantly "syllabus tinkering" in the 1980s, but has seen dramatic pedagogic shifts in pedagogy after 1990. I have sought to find some place where one might begin a process of unpacking the ideological intent of mathematics curricula in this country. I have looked for some place where the structuring of curricula for mathematics was discussed; where perspectives on mathematical knowledge, students and learning, teachers and teaching, were debated and shaped into official curriculum documents; I wanted to find statements of intent outside of the final product (that is, the written curriculum). At the same time I wanted to get a picture of what relations of power made debates and discussions possible, who contributed and who listened and to what extent these were contested ideas?

One such place was the activities of the Mathematics Association of South Africa (MASA), an exclusively white association until 1983/5, of academics and predominantly secondary mathematics teachers. These acivities included hosting conferences, establishing a journal (*Pythagoras*) and commissioning research. It is the research commissioned by MASA that is the object of study here. This research, commissioned in 1970, represents a systematic corpus of research into mathematics education in South Africa. They reflect upon the state of mathematics education in South Africa in the 1970s and make recommendations for mathematics curriculum

"innovations" that include the introduction of differentiated school mathematics syllabuses, the restructuring of teacher training courses and bureaucratic procedures for implementing curriculum changes. The research reports discuss the nature of mathematics, the selection and organisation of mathematical contents in school mathematics syllabuses, issues in the teaching and learning of school mathematics and describe teachers and students in particular ways. This study attempts to produce a systematic analysis of these research reports that may provide a general language for analysing curriculum documents; documents that entail knowledge pertaining to the teaching and learning of school subjects. It is hoped that the analysis will highlight aspects related to influences, outcomes and effects of mathematics curricula in South Africa.

Chapter 3

Theoretical Framework and Methodology

3.1 Introduction

The central focus of this chapter is to develop and outline a methodology for analysing the research reports. The literature review in the previous chapter focused on issues relating to curriculum construction and reform as a way of locating my own study within the field. In this chapter I shall start by extending the literature survey to focus on curriculum theory and different approaches to analysing curriculum knowledge in South Africa. This discussion serves as a background to the framing of my own methodology. I shall then outline the theoretical model that I have used as a methodological tool for analysing the reports. The chapter will conclude with a brief description of how the analysis was conducted.

3.2 Curriculum Theory in South Africa

Schools in South Africa have been sites of political struggle against apartheid education for more than three decades. These struggles have taken many different forms, not least of which has been challenges to official curricula and a search for alternative curricula.[1] Within this context, contestation around what constitutes school knowledge has always been overtly political; official curricula have always been seen as part of the apartheid grand plan to perpetuate racial discrimination and oppression. Taylor (1993: 1) therefore suggests that, given the particular transparency of the political nature of school knowledge in this country, where South African studies address theoretical issues, it is entirely appropriate that "they adopt a sociology of knowledge perspective". He asserts that a sociology of knowledge perspective can be traced back to the emergence of the "New Sociology of Education

[1] For example, the "People's Education" Campaign in the 1980s co-ordinated by a National Education Co-ordinating Committee, led the search for alternative curricula, methodologies and materials. However, their focus always remained outside of official school knowledge.

(NSOE)" in the 1970s. He describes the principal focus of the NSOE tradition in terms of a statement by Bernstein (1971) on the issue of curriculum knowledge:

> how a society selects, classifies, distributes, transmits and evaluates the educational knowledge it considers to be public, reflects both the distribution of power and the principle of social control (Bernstein, 1971: 47, in Taylor, 1993: 2)

Studies in this tradition focusing on the construction of school knowledge were thus centrally concerned with issues relating to knowledge and social reproduction, knowledge and control and knowledge and power. They attempted, in Young's (1993) words, "to lay bare the politics of the curriculum". In a volume that reflects upon ways of restructuring the school curriculum in South Africa and grapples with the issue of producing knowledge for a democratic future, Taylor (1993) provides some insights and shortcomings of the NSOE tradition which I will draw on in the discussion below. The purpose simultaneously is to consider current perspectives on the sociology of school knowledge and to indicate where my own theoretical interests lie.

I will discuss here, three main currents in curriculum theory in South Africa, namely, neo-Marxist reproduction theories, theories in the "New Sociology of Education" tradition and theories that draw on a Foucauldian perspective.

3.2.1 neo-Marxism: Knowledge and social reproduction

Several studies in the previous chapter related curriculum knowledge to the interests of dominant social groups and argued that the primary social function of the curriculum is the reproduction of the (ideological and material) interests of these dominant groups. In South Africa, this view was taken up in the 1980s by neo-Marxist critiques of apartheid education well represented in a collection of papers in Kallaway (1984), in which issues of racial oppression dominated arguments. Muller (1996) refers to these arguments as "Marxism of a special type" where:

> The "state" which was the target of critique and struggle, was tacitly assumed to be the "apartheid state"; the reproductiveness of schooling was the fault of "Bantu education"; ideology was "apartheid ideology"; and the ruling class was the whites (Muller, 1996: 180).

These studies have been criticised by Taylor (1993: 2) for slipping "into crude theories of reproduction of a monolithic dominant group on one hand, and ineffectual resistance by marginalised groups on the other". Wolpe et al (1991) make similar criticisms of the collection of articles in Kallaway (1984) that attempted to explore the relationship between race, class and education. They argue that these articles quite unproblematically adopted a functionalist form of argument in which "the state, as the instrument of capital, develops and implements education policies which serve to reproduce capitalism" (Wolpe et al, 1991: 6).

Wolpe et al (1991) describe two forms these arguments took: on one hand, educational policy changes were explained as a response to increasing technological developments and consequent changes in labour demands from capital (e.g. Hartwig and Sharp, 1984; Chisholm, 1984; Christie and Collins, 1984), on the other, policy reforms were explained as smokescreens for maintaining and reproducing the existing unequal racial division of labour (e.g. Buckland, 1984; Davies, 1984). They argue that both these approaches assumed "that the functional requirements of the capitalist system for a particular labour force produce the means to satisfy those needs" (Wolpe et al, 1991: 6). Both Wolpe et al (1991) and Taylor (1993) argue that the shortcomings of "crude reproduction" studies are that they neglect to analyse contestations over educational knowledge or contradictions that emerge between education and other, changing, components of the social structure. Muller (1996: 181) refers to further studies by Bloch (1988) and Molteno (1987) as "critical in intent, but also frankly triumphalist".

Several studies have attempted to move beyond "crude reproduction theories" Young (1993), for example, argues that in modern capitalist societies there is an increasing move towards new forms of specialisation for the whole population, that is, "new combinations of knowledge and skills", such that "the traditional separation between skill and knowledge begins to lose its meaning, together with its basis for the division between mental and manual labour which was the distinctive characteristic of earlier phases of industrialisation" (Young, 1993: 20).

To cope with these changes, he argues that societies have to find ways "of substantially increasing both their levels of participation in post-compulsory education and their levels of achievement" (Young, 1993: 20). In his analysis therefore he focuses on the relationship between "modernising" strategies of the curriculum and their systems of qualifications. Using the UK post-compulsory curriculum as a case study, he argues that the strategy of "modernisation", to extend the qualification system and so maximise the numbers developing specialist knowledge, is contradicted by the principle of *qualifications for selection* and by the maintenance of a separation between academic and vocational qualifications. This contradiction, he asserts, enables a divided curriculum in the UK, under a Conservative government, to "become a mechanism for ensuring that the democratic component of modernisation is limited and traditional hierarchies are maintained" (Young, 1993: 20). He refers for example to the A level academic examinations which effectively select out only "20 per cent of 16 year olds", while the rest are meant to attain vocational qualifications. However, he argues that very few of them do, because within the divided system, academic qualifications (still) carry higher status, and so many "continue to take the risk attached to A levels, with the inevitable increases in failure rates, and in the end disillusion, disenchantment and dropping out" (Young, 1993:28). In other words, participation and levels of achievement in post-compulsory education remain low within such a divided system. Young's analysis thus highlights aspects of the relationship between curriculum and qualifications that suggest that theories of reproduction have to move beyond simply providing a critical awareness of how capitalism works.

In addition to changes in the social division of labour, Apple (1992) and Taylor (1993), point also to the increasing fragmentation and blurring of boundaries between class relationships in post-modern capitalist societies. They argue that class is becoming increasingly "gendered and raced" and so rendered "progressively less useful as a fundamental unit of analysis" (Taylor, 1993: 5). Bernstein (1996: 11) however maintains that "despite clear indications of improvements in working class/race/gender educational chances, social class is a major regulator of the distribution of students to privileging discourses and institutions". Much of his work

still implicates class culture in differential forms of curriculum knowledge. He maintains that curriculum knowledge, or what he refers to as pedagogic communication, is a relay for power relations external to itself. It is a relay for class relations, economic relations, gender relations, religious relations as well as, political ideologies. It is a relay "for patterns of dominance external to itself" (Bernstein, 1990: 169). This is the case, he argues, despite increasing attempts to mask these patterns of dominance in the organisation of curriculum knowledge. He refers for example, to curricula that create discourses which emphasise what all social groups share, that is, their commonality and apparent interdependence. Bernstein (1996: 9) claims that such discourses generate "*horizontal solidarities* whose object is to contain and ameliorate vertical (hierarchical) cleavages between social groups". He proposes that such discourses are "mythological" since they operate within a system (schools) which necessarily produces a hierarchy based on success and failure and therefore always has consequences for occupational class hierarchies outside the school[2]. Furthermore, he asserts that they always incorporate some of the political ideology and arrangement of society. In his thesis he focuses not only on what is reproduced through curriculum knowledge, but also on the structuring of pedagogic communication, and again, he looks at how this structure works to maintain dominant interests and power relations.

3.2.2 The NSOE and curriculum theorising in SA

Many theories of reproduction are premised on a belief that there is a direct correspondence between curriculum knowledge and dominant social interests. The more critical theories suggest that the correspondence is not simple in that there are a range of social actors and forces that contest the nature and canonisation of curriculum knowledge, so that the issue of knowledge and control becomes more complex. In particular, Taylor (1993) refers to studies, discussed here in chapter 2, by Moon (1986) and Goodson (1983 to 1990) that premise "a greater degree of relative

[2] He refers to one such mythological discourse as creating a myth of *National Consciousness*, which proposes that society is an organism in which groups within society, but not necessarily groups *between* societies, relate to each other through *interdependence* of specialised functions. In other words, all functions have *equivalence of value* despite differences in power, resources and potential (Bernstein, 1996: 10). He asserts for example, that gender relations are maintained in this way.

autonomy between class, professional and a range of other interests in competing for the legitimation of knowledge" (Taylor, 1993: 9). Moon's (1986) study for example, argued that the nature of school mathematics was contingent upon struggles between academic mathematicians, mathematics educators, teachers, commercial publishers, administrators, parent groups, representatives of industry and commerce, politicians and international agencies such as UNESCO and OECD (Taylor, 1993: 9). In other words, a range of "interested" parties, at some time or another, and to different degrees, determined what counted as legitimate curriculum knowledge. Each party, seemingly, acted in their own interests.

A more sophisticated view of curriculum knowledge and control is advanced by Muller and Taylor (1993). They define three specialised domains[3] that deal centrally with the curriculum and consider how curriculum knowledge circulates across these domains and what the institutional dynamics in each domain are. The three domains are the academic domain, the bureaucratic domain and the school itself (Muller and Taylor, 1993: 313). They argue that each domain "is characterised by specialised interests, institutional locations and forms of knowledge" (Muller and Taylor, 1993: 314). They assert that knowledge circulates within and between these domains through processes of *redescription*[4] which rarely leaves the knowledge unaffected and invariably favours a particular interest group:

> Each act of description, redescription or authorisation involves a relation of power, a contest between a number of contending interpretations which in turn are linked to social interests. These struggles for authority, for control of the nodes of knowledge invention, occur both within and between domains. Different individuals and groupings bring profoundly unequal capacities and command of the rules to these sites of struggle. Consequently, the outcomes of knowledge production almost invariably favour a particular configuration of interests (Taylor, 1993: 14).

They argue, thus, that redescription is a process that always involves the exercise of symbolic power, and in extreme forms may be manifested as surplus power:

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[3] They use domains to mean sites "where cultural, power and institutional dynamics interpenetrate" and which are "fundamentally in tension or conflict about definitions of what constitutes legitimate practice" (Muller and Taylor, 1993: footnote 1, 327)

[4] By this they mean the process entailed in the movement from interpretation of knowledge to canonisation and legislation of knowledge in curricula.

> If the power of the redescription is magnified by structure and/or struggle, redescription not only humiliates, but can also maim and silence. When this happens, then necessary authority and power become surplus power, which in turn simply means that the redescription comes to serve one set of interests at the expense of speaking for a common interest (Muller and Taylor, 1993: 315).

Within the academic domain they describe the elaborated and highly technical nature of academic discourses as creating a sharp disjuncture between the everyday and academic domains, thereby excluding all but the initiated, from participation in such debates. This, they say, effectively grounds, that is controls and legitimises, the school curriculum within the academic domain. In addition, they assert that academic legislators, such as examiners, editors, referees, peer review boards and degree committees, exercise "surplus canonical authority" over curriculum writers in the sense that "curriculum writers are overawed by their academic teachers[5] to the point where they are usually unable to formulate curricula that serve the needs of their constituents" (Muller and Taylor, 1993: 319). Their analysis suggests therefore, that the influence that academics have over what counts as school knowledge is not co-incidental - the social practices within the domain create the conditions for exercising control over the legitimation of school knowledge.

With regard to social practices within the bureaucratic domain, they claim that this domain suffers from surplus authority directed at it from both the State and academic spheres:

> Surplus political authority ensures a political homogeneity within the bureaucracy which tends to stifle debate and encourage corruption. Surplus academic authority, on the other hand, results in the reification and opacity of knowledge and its monopolisation (ibid: 324).

The distinction between the bureaucratic domain and the State is based on a distinction between respective administrative and political control over the curriculum. It is a distinction between legislative functions of the State on one hand and interpretative functions of education departments and their agencies (the bureaucracy) on the other. These interpretative functions are associated with what is known as the *written* curriculum. This includes the writing of curriculum frameworks, syllabuses, teacher guides, textbooks and public examinations. Practices

[5] They note that curriculum writers are themselves graduates of the academy.

within the bureaucratic domain are described as "fundamentally anti-democratic in that it excludes from participation all the major interest groups in society" (Muller and Taylor, 1993: 321). They argue for example, that the "top-down" process of curriculum change, that is, the handing over of finished products - syllabuses and textbooks - to teachers for implementation, "is based on an epistemology that underlies all forms of authoritarian canonisation" (Muller and Taylor, 1993: 321). They describe this form of control as disempowering to teachers, not only because teachers are excluded from the process of knowledge production, but also because it places the onus on the teacher "to extract the new content and methodology from the [syllabus] text, [and] failure to do this is entirely his or her own fault" (ibid: 322). Furthermore, within the domain of school, certification procedures and systems of inspection are described as devices which serve to align the bureaucratic and school domains such that schools become "highly controlled instructional sites where the official ideology is reproduced" (ibid: 323). In this sense, they maintain a strong link between knowledge and social reproduction.

Muller and Taylor's argument (1993; 1995) draws extensively on Bernstein's (1990;1996) account of State regulation of curriculum knowledge. He describes three field categories of educational practice, namely, intellectual fields, fields of reproduction and recontextualising fields. The *intellectual fields* are similar to the "academic domain" and the *fields of reproduction* are essentially school or college practices. Bernstein argues that, located between these two fields is the *recontextualising field.* Within this field, the primary function is "creating, maintaining, changing, and legitimising discourse, transmission, and organisational practices which regulate the internal orderings of pedagogic discourse" (Bernstein, 1990: 193). It is situated between the other two fields because, he argues, to constitute pedagogic discourse in this field, discourses are appropriated from intellectual fields, recontextualised[6] in this field, and then reproduced in the fields of reproduction. The recontextualising field thus structures, and therefore exercises control over, curriculum knowledge.

[6] Muller and Taylor (1995: 208) refer to the same process as "redescription" or re-interpretation.

He describes two recontextualising fields central to the curriculum. The first he calls the *Official pedagogic recontextualising field* (ORF) which is constituted by specialised departments and sub-agencies of the State and local educational authorities together with their research and system of inspections.[7]. The second field, he calls the *Pedagogic recontextualising field* (PRF) which includes practices of academics, college lecturers professional associations, private research foundations, educational media as well as, educational influences from the business sector. Both fields are influenced by the economic field and field of symbolic control. However, the ORF regulates official pedagogic discourse[8] and expresses the dominant principles[9] in society. Furthermore, it also regulates activities of the PRF. The relative autonomy of the PRF rests upon the organisation of the ORF (centralised or decentralised) and the extent to which the ORF regulates pedagogic discourse of reproduction. In other words, the relative autonomy of the PRF is defined in terms of the extent to which the PRF is permitted to exist and exercise control over official pedagogic discourse. For example, where there is highly centralised control over curriculum knowledge with centralised systems of assessment and inspection there is a highly attenuated ORF. In such cases, the ORF structures pedagogic discourse of reproduction so that the dominant principles of society are reproduced and, such activities as do exist within the PRF are severely limited. Muller and Taylor (1995: 218) make this argument with respect to the relationship between the ORF and PRF within the apartheid education system in South Africa:

> This was true for apartheid education, which was administratively decentralised for 40 years, but strongly centralised at the symbolic level. Access to the writing of syllabi and textbooks was tightly controlled by the bureaucracy through white administrative and political cliques.

In contrast, Bernstein (1990) describes the education system in the UK where the PRF enjoyed a relatively autonomous existence. Within such a decentralised system, activities within the PRF could "recontextualise texts which *in their own right* may be

[7] Muller and Taylor (1995: 207) refer to this field as the *bureaucracy*.
[8] That is, "official rules regulating production, distribution, reproduction, interrelation, and change of legitimate pedagogic texts (discourse), their social relations of transmission and acquisition (practice), and the organisation of their contexts (organisation)" (Bernstein, 1990: 193).
[9] That is, expressions of the dominant political party of the State.

considered illegitimate, oppositional, originating in counter-hegemonic sites of production of discourse" (Bernstein, 1990: 202).

In grappling with the issue of knowledge, control and power, Muller and Taylor's work, as well as Bernstein's point to more than just social actors who contest the nature and legitimacy of school knowledge. Rather, they highlight ways in which knowledge is authorised within different domains and fields and how knowledge circulates between these domains, such that they control and regulate what counts as legitimate knowledge in the school curriculum. In addition, their perspectives emphasise the relationship between curriculum knowledge, state control, power and social reproduction.

3.2.3 Curriculum knowledge and "the production of truth"

Curriculum knowledge has also been analysed from a perspective that places emphasis on relations of power and the discursive effect of school knowledge. This perspective draws particularly on the work of Foucault (1972) and has tended to background social relations. From this perspective, schooling is not seen as a medium for social reproduction nor is curriculum knowledge seen as simply the product of contestations by different interest groups. The view here rather, is that curriculum knowledge and schooling is a vehicle *of* power that establishes relations through which "knowledge is produced, discipline exercised and teachers and learners subjected" (Deacon & Parker, 1993: 136). It is a view based on the Foucauldian notion of discourses which "systematically form the objects of which they speak...they do not identify objects, they constitute them" (Foucault, 1972: 137). In other words, they are discursive practices which constitute teachers and learners as specialised human subjects, subject to power-knowledge relations. Ball (1990: 2) interprets Foucault's notion of discourse as that which embodies "meaning and social relationships", and constitutes "both subjectivity and power relations".

To elaborate, Foucault (1982) analyses practices within and between various domains and reconceptualises power and power relations to mean the following:

> The exercise of power is not simply a relationship between partners, individual or collective; it is a way in which certain actions modify others (Foucault, 1982: 219).

> In itself the exercise of power is not violence; nor is it a consent, which implicitly, is renewable. It is a total structure of actions brought to bear upon possible actions; it incites, it induces, it seduces, it makes easier or more difficult; in the extreme it constrains or forbids absolutely; it is nevertheless always a way of acting on an acting subject (ibid: 220).

From this perspective, power relations mean much more than simply the effects of *hierarchical* relationships between people or domains of social practice - they signify a mode of action which regulates or structures the possible field of action of others. Foucault refers to this mode of action as "government":

> Basically power is less a confrontation between two adversaries or the linking of one to the other than a question of government. [...] ['Government'] did not only cover the legitimately constituted forms of political or economic subjection, but also modes of action, more or less considered and calculated, which were destined to act upon the possibilities of action of other people (ibid: 221).

We see in this conception of power relations, that power is exercised over "free subjects", that is, "individuals or collective subjects who are faced with a field of possibilities in which several ways of behaving, several reactions and diverse comportments may be realised" (ibid: 221). In other words, relations of power structure "choices" that are made within a field of possible actions. We may relate this to the relationship between the bureaucratic domain, academic domain and school domain, described by Muller and Taylor (1993) earlier. They described how the "surplus power" in one domain regulates the actions/practices in another domain.

Foucault (1982) also does not view power simply as a repressive, centralised, homogeneous force, imposed onto individual or collective subjects externally:

> We must cease once and for all to describe the effects of power in negative terms: it "excludes", it "represses", it "censors", it "abstracts", it "masks", it "conceals". In fact power produces; it produces reality; it produces domains of objects and rituals of truth. The individual and the knowledge that may be gained of him belong to this production (Foucault, 1977: 194).

> Power is not an individual or group's consolidated and homogeneous domination over others, but something that circulates, a chain, a net, a web, where individuals both undergo and exercise power, and are both its target and the elements of its articulation (Foucault, 1986: 234).

It is through this conception that we see the link he makes between power and knowledge, for power produces knowledge as "rituals of truth", but knowledge produces power through its networks of communication. Foucault refers to the relationship between knowledge and power as "power-knowledge relations" to indicate that it is a reciprocal relationship, where the one implies the other:

> [T]here is no power relation without the correlative constitution of a field of knowledge, nor any knowledge that does not presuppose and constitute at the same time power relations (Foucault, 1977: 27) [10]:

From this perspective we may consider curriculum knowledge as "rituals of truth" that are the effects of "power-knowledge relations". This includes the conditions that establish relations of power as well as the production of knowledge or "rituals of truth" made possible through these power relations. Using Foucault's conception of power-knowledge, Deacon and Parker (1993: 137) suggest that in analysing curriculum knowledge in SA, "the starting-point ought not to be descriptions of the apparent subjects[11], the actors and their interactions, but ought rather to be the relations of power within which these subjects are embedded". They argue also that curriculum knowledge constitutes human subjects:

> "our" "knowledge" of "reality" and of "ourselves", and more specifically of "curriculum" and "rural schooling" are effects of power, which constitutes us as subjects and permeates our knowledge by constructing its objects (Deacon and Parker ,1993: 138)

Foucault (1977: 94) makes a similar statement in an earlier quote with respect to the production of truth through power relations, that the "individual and the knowledge that may be gained of him belong to this production". Foucault (1982: 212) explains what it means for an individual to become a subject:

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[10] Hoskin (1990: 51) argues that despite this dictum, Foucault in fact developed only half a theory, of power-knowledge, but not of knowledge-power. He suggests that power and knowledge do not in any simple way imply each other; they do so only in certain specific and specifiable respects, through the operation of a third term, which is not the same as, or reducible to, either one of them. He proposes that "discipline" and "examination" are candidates for this third term through which power-knowledge operates.

[11] They are referring here to subject knowledge.

> There are two meanings to the word *subject*: subject to someone else by control and dependence, and tied to his own identity by a conscience or self-knowledge. Both meanings suggest a form of power which subjugates and makes subject to.

Thus, becoming a subject necessarily entails subjection. It also suggests that who you are, what you know and what you can say, is a function of the relations of power of which you are invariably a part.[12] Teachers and learners are thus subjected to power-knowledge relations established through the discursive practices of schooling and curriculum knowledge which regulates the way they think and act.

Bernstein (1990: 134) describes Foucault's analysis of power, knowledge and discourse as "a mighty attempt to show new forms of the discursive positioning of the subject". However, he also offers a critical view of Foucault's analysis. He claims that Foucault's analysis is "in a way a discourse without social relations" in that "there is no substantive analysis of the complex of agencies, agents, social relations through which power, knowledge, and discourse are brought into play as regulative devices; nor any discussion of the modalities of control" (Bernstein, 1990: 134). In a sense Bernstein is arguing that Foucault's work does not sufficiently analyse aspects that earlier work highlighted, that is, the relationship between knowledge, social reproduction and control. While this criticism is valid in the context of curriculum knowledge, I would assert that Foucault's notion of power is still useful in analysing power relations in the context of curriculum production, since it is a context dependent on the circulation of knowledge.

3.3 Summary

Perspectives on the sociology of knowledge in South Africa and possibly elsewhere, have shifted from "crude theories of reproduction", which linked "legitimate" knowledge to the interests of mainly dominant political or economic social groups, to theories which premised the relative autonomy of social groups competing for the legitimation of knowledge. These theories linked school knowledge to the interests of

[12] Foucault (1982: 222) maintains that power relations are rooted deep in the social nexus and that to live in a society, is to live in such a way that action upon actions is possible - and in fact ongoing. Furthermore, a society without power relations can only be an abstraction.

a wider range of social groups. Perspectives shifted from crude reproduction theories to considering knowledge as social practice and distinguishing between different domains of practice. Besides the function of social reproduction, this view looked more closely at the relationship between knowledge, control, power and social practice. In particular, it considered how knowledge is authorised in different domains and how knowledge circulates between domains or fields such that they control and regulate what counts as legitimate knowledge in the school curriculum. Here, the function of state apparatuses was especially implicated. A somewhat different perspective of school knowledge, influenced by the work of Foucault, proposed an understanding of curriculum knowledge as the production of discourse, where the notion of discourse incorporates social relations. The latter perspective allowed for a closer analysis of the relationship between knowledge and power and introduced the view of individuals constituted as specialised subjects through the production of discourse.

My own theoretical approach has been framed by the above discussion in that I have adopted a "sociology of knowledge" perspective to the analysis of curriculum knowledge in the reports. The domains and fields described by Muller and Taylor (1993) and Bernstein (1990) will be used to situate the research reports within the field of curriculum production and reproduction. The analysis will consider school mathematics in the reports from the perspective of the production of pedagogic discourse. This means that school mathematics embodies specialised meaning and social relationships and constitutes both subjectivity and power relations. As such, the analysis will focus particularly on teachers and learners as specialised subjects constituted through the production of pedagogic discourse, that is, school mathematics. In other words, it will consider how teachers and learners described in the reports are constituted as subjects inscribed within, or constructed by, social relations. In the next section I shall use Bernstein's (1990) categories of recontextualising fields to situtate the HSRC reports and shall then explore Dowling's (1996) language of description as a methodology for analysing the reports.

3.4 Analytic framework and methodology

This section describes a framework to *locate* the empirical texts as well as to *read* them.

3.4.1 Contextualising the reports

The problematic here relates to the location of the research reports, in terms of their practice, within the field of curriculum production and reproduction. In particular, there is an ambivalence about whether this research, conducted independently of state departments, could be argued to represent the State's view, that is, the official view on mathematics curriculum innovations. An ambivalence surrounds the accountability of the research and why it was commissioned. Firstly, the research was commissioned by the Mathematical Association of South Africa (MASA) in 1970. At that time, this association was an exclusively white association of academics and teachers and in fact remained so until the late 1980s. Its members included university lecturers and predominantly secondary teachers. Within the context of a racially segregated system of education, it is difficult to consider the interests of an exclusively white professional association separate from those of the white minority ruling party. Nonetheless, it was not directly state-commissioned research and the proposals for curriculum innovations that are made, are seemingly posed as a challenge to existing state curricula. Secondly, the research was conducted by the Human Sciences Research Council (HSRC), described by Behr (1988: 80) as a "corporate body outside of the public service but which fell under the Department of National Education", and by Malherbe (1977: 392) as a Council "independent of a government department". The relationship between the Council itself and the State is thus also ambiguous. While none of the authors of the research reports were employed by state departments, the ad hoc committee appointed by the HSRC to evaluate the reports and advise the researcher, included at least five members from national and provincial education departments. All these committee members were white males, except for one white female principal. These circumstances around the reports posed a difficulty with regard to claims that the curriculum statements in the reports represented official

views on mathematics instruction. It is for this reason that I want to consider the status of the reports in terms of Bernstein's (1990) discussion of recontextualising fields, in particular, the relationship between the Official Recontextualising Field (ORF) and the Pedagogic Recontextualising Field (PRF).

Behr (1988: 80) describes the activities of the HSRC as follows:

> The HSRC undertakes, promotes and co-ordinates research in the human sciences, advises the Government and other bodies on the utilisation of research findings, and disseminates information on the human sciences. [...] In essence the HSRC is concerned with the 'manner in which the potentialities of the inhabitants of the country can best be utilised. [...] The Institute for Educational Research is responsible, too, for undertaking research at the request of the various education departments in the RSA, other departments and organisations.

This description suggests that the HSRC is an agency within the ORF. It is used as an official research agency by the State bureaucracy and functions effectively as an official agency of symbolic control. The reports, in terms of their institutional location, may therefore be situated within the ORF. This is consistent with the positioning of bureaucratic agents as the readers of the reports. Recommendations for example state that "authorities must make provision for revision of syllabuses", "the Joint Matriculation Board must make provision to exempt schools from core examinations",, "the syllabus compilers must...", and so on. In other words, the research and recommendations of the reports are meant for circulation within the ORF. However, there is also a reverse effect. In positioning bureaucrats as readers, the author of the reports is distanced from the readers, suggesting that the *practices* of the author are different to those of the reader. It also suggests that the author is an "independent" researcher offering a view from "outside". It could be argued that the view from "outside" emanates from within the PRF.

The involvement of MASA in initiating the research, suggests for example, that the reports may be associated with activities of the PRF. The reports are prefaced by a research brief outlined by MASA, not from some official source, suggesting that the research is of *professional* interest. This is also suggested by the data-gathering processes described for the research. The reports refer to visits to schools,

universities, research institutes in addition to education departments. The reports are characterised by motivations for change, and challenges to the prevalent views and practices of mathematics instruction and teacher education in South Africa. They report on experiences of innovation projects in other countries (mostly located within the PRF of respective countries), recount different peoples' views on the teaching and learning of mathematics and make recommendations on the basis of these. In this sense, statements in the reports refer largely to activities within the PRF of various countries. That is, the statements describe innovation programmes in different countries from their perspectives on mathematics, teaching and learning.

It may be argued that we have in these reports, statements from the PRF and ORF in other countries recontextualised within the ORF in South Africa. Furthermore, this recontextualising is supported by agents of the PRF in this country. This raises interesting questions about the relationship between the ORF and PRF in South Africa. It was stated earlier that the ORF is regulated by dominant principles in society and it regulates official pedagogic discourse. One question to ask is how have statements from the PRF been recontextualised in the ORF? The question relates to another, namely, how do the statements in the reports express dominant principles in society if they have been recontextualised in the ORF and why is this supported by agents of the PRF? Two further questions relating to the broader curriculum context in which the reports are produced, arise. Muller and Taylor (1995) and Julie (1990) have made reference to the highly centralised system of curriculum control dominant in the apartheid education system. In Bernstein's terms, only the ORF exercises symbolic control within such a system. Muller and Taylor (1995) underscore this point in their discussion of the limited activities of the PRF within the apartheid education system. The first question that arises is why, at this time, does the ORF exert symbolic control by recontextualising discourses supported by the PRF? Secondly, if activities of the PRF have been limited within the South African context, to what extent do the innovations proposed here, pre-figure current official pedagogic discourse?

3.4.2 Analysing the reports

The research reports being analysed here focus on school mathematics. Their concern is not only with teaching and learning in the classroom, but also with aspects of syllabus construction, teacher training and issues around curriculum implementation. As such, they refer, amongst others, to practices of bureaucrats, academics, teacher trainers, teachers and students. They distinguish these groups in terms of what they know, what they should know, what they do and what they should do. They also differentiate within groups, referring for example, to different categories of teachers and students. In this sense, school mathematics as constituted in the reports may be understood in Dowling's (1996) terms as constituting an *activity*. By this he means that school mathematics specialises practices and positions. Using this conception of *activity*, Dowling outlines a model for analysing *social activity* and the texts it produces, which I will first elaborate and then explain how it was used as a methodological framework in my own analysis.

3.4.2.1 An analytic model

Dowling (forthcoming) introduces a theoretical language which is framed within what he calls *social activity theory*. In his language, "activity" constitutes an analytic space and is always ideologised in the empirical. That is, activities are, themselves, "constituted by (and (re)productive[13] of) the division of labour in society" (ibid). Within his theory he introduces three analytic levels of *activity*: the structural level, the level of event and the level of resources. At the *structural level* activity is defined as follows:

> Activity is to be understood as the contextualising basis of social practices. Thus, firstly, any particular activity must specialise *practices*. [...] An activity thus regulates what can be said or done or meant. Secondly, an activity establishes one or more positions which can be occupied by human individuals; these are specialised *positions*. [...] Positions are understood, here, to be constitutive of human subjectivity rather than syndromes of expected behaviours [...]. Concrete human *subjectivities* are to be interpreted as articulations of multiple positions. (Dowling, forthcoming, emphasis in original)

[13] Dowling uses the motif (re)production to show the dialectic between production and reproduction.

At the structural level then, activity constructs positions and distributes practices to them. This level regulates who can say what within the activity. The second level is what Dowling calls the *level of event*. At this level practices and positions of an activity are (re)produced firstly, by *human subjectivities*[14] and secondly, by *texts*[15]. Since his empirical focus is on texts rather than subjectivity, he refers to this level as the *textual level* of his language[16]. At this level, the instantiation of *practices* is referred to as *message* and the instantiation of *positions* is referred to as *voices*.

In Dowling's (1995) thesis school mathematics is the activity and his texts are pedagogic texts. In these texts, school mathematics learning contents are used to constitute message and voice. He thus produces an analysis of school mathematics texts to show how practices (of school mathematics) and subject positions (for transmitters and acquirers) are (re)produced in the texts. The empirical texts in my study are curriculum texts rather than pedagogic texts. As such, pedagogic prescriptions that define theories of instruction, pedagogic contexts and mathematical contents as well as curriculum innovation discourses, constitute message and voice in the reports. In other words, message in the reports entails discourses around the teaching and learning of school mathematics rather than school mathematics learning contents. Subject positions which are (re)produced, that is, voices in the text, include transmitters and acquirers as well as academics and bureaucrats who also "participate" in the (re)production of pedagogic discourse.

Dowling (ibid: 102) argues that "message and voice are the direct products of the analysis of a particular text". By this he means that, any given text constructs a range of voices via the distribution of message, which correspond to "a subset of the range of positions constructed by the activity" (Dowling, ibid: 102). In Dowling's model, the relationship between the structural and textual levels is said to be dialectical, where "the practices and positions of an activity are structuring resources in the production of texts which, themselves, are produced as well as reproduced by texts"

[14] These are to be interpreted as articulations of multiple subject positions.
[15] Text is defined as "an utterance or set or sequence of utterances made within the context of one or more activities" (Dowling, forthcoming)
[16] Since texts are also my empirical focus, I will also refer to this level as the textual level.

(Dowling, ibid: 102). In this sense, the structural level (activity) is accessible only via the level of events (subjectivity/texts). In other words, practices and positions are to be inferred from the analysis of subjectivity/texts.

He argues further that, message and voice are constituted via *textual strategies* and according to Dowling "it is these strategies and the patterns of voice and message that must be identified in and by the analysis [of texts]" (Dowling, 1995: 102). In his analysis he describes *message strategies* as illustrations of the (re)production of practices, *distributing strategies* as the (re)production of subject positions via the distribution of message over the range of voices and, *voice positioning strategies* which act directly on voice to (re)produce subject positions.

At the third level of Dowling's model, textual strategies recruit *textual resources*. Textual resources are arbitrary in the sense that "there is no *a priori* limitation on what can count as a resource. Nor is there a predetermination on how they are implicated into the various textual strategies" (Dowling, ibid: 106). Crucially, arbitrariness of resources has to be understood as purely theoretical, for Dowling points out that:

> Empirically, there must always be a selection from a notional *reservoir* of resources to constitute the *repertoire* of resources which make up a particular text. The differential selection of resources in relation to different voices is crucial in the realising of [textual strategies] (Dowling, ibid: 106, emphasis in original).

Following Dowling's theoretical language, the analysis of texts must produce descriptions of: its voice topography; the distribution of message across the voice topography; the textual strategies which constitute voices and message and descriptions of the resources which they recruit. Since texts are viewed here as material instances of activity, specialised practices and positions structured by the activity are to be inferred from the analysis. To summarise, the structure of the model may be represented diagrammatically as follows:

Features of Dowling's (1995) analytic model

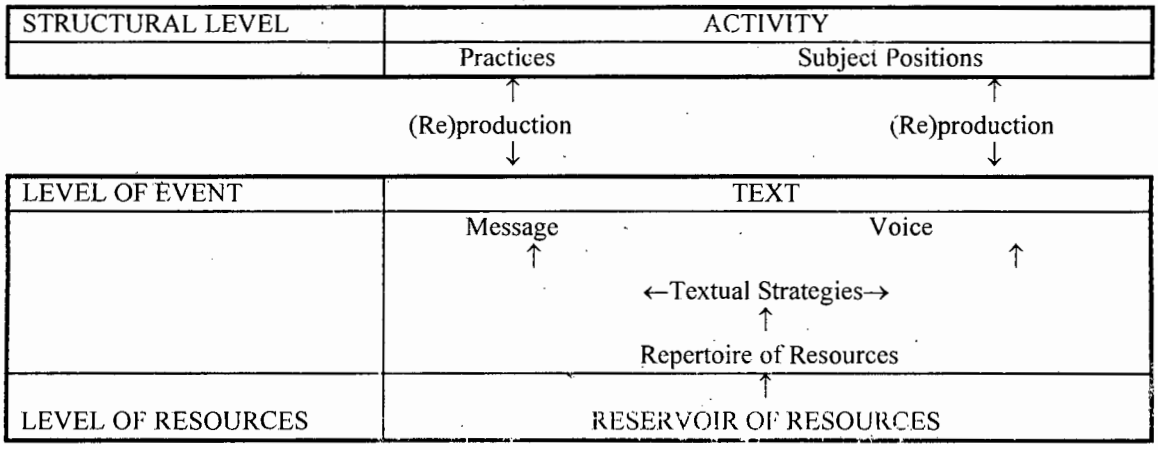

FIGURE 3.1
(adapted from Dowling, 1995: 121)

3.4.2.2 Methodology

The empirical focus of this study is a set of research reports concerned with the promotion of innovation in the instruction of school mathematics in SA. As such, they discuss issues relating to the aims of mathematics instruction; problems relating to the implementation of innovation in SA; criteria for the compilation of differentiated syllabuses and the training of mathematics teachers. In doing so, they discuss and privilege particular views of mathematical knowledge, of learning and teaching and they differentiate and construct mathematical knowledge, students and teachers in particular ways. This study set out to produce an analysis of how the reports achieve this and what the implications of their constructions are. Thus, the focus of the analysis is on how the reports (re)produce school mathematics and the central methodological issue is, how are they to be analysed?

Using Dowling's (1995) model as a methodological framework, the HSRC research reports will be viewed here as material instances of the activity of school mathematics. In the analysis, academics, bureaucrats, teachers and students will thus be described as voices in the text. These are voices inscribed in or constructed by, social practices and relations. Their positioning, in relation to each other and to the activity, will be analysed in terms of *positioning strategies* which act directly on

voice, and *distributing strategies* which distribute message across the range of voices. Knowledge and practices that constitute message in the reports relate to mathematical knowledge as well as theories of instruction and curriculum innovation practices.

3.4.3 Voices and positioning strategies

Dowling (forthcoming) asserts that any given monologic text[17] may constitute an authorial voice which is dominant and one or more reader voices which are subaltern voices. In the reports, the authorial voice is the researcher voice and the reader voices are bureaucrats and mathematics curriculum developers. The authorial voice is the dominant voice; it is the organising voice of the text and as such it recruits textual strategies to position itself and other voices and to distribute message across voices. The analysis will consider how the authorial voice acts selectively on available resources to produce positioning and distributing strategies. Positioning strategies establish relationships of dominance and subordinance between voices in the texts. For purposes of my analysis I shall consider the following positioning strategies taken from Dowling (forthcoming):

- *affiliation* (authorial identification with another voice e.g. claiming an association with professional mathematicians);
- *displacement* (authorial identification with a reader voice e.g. claiming empathy with bureaucratic difficulties for implementing innovations) [18];
- *objectification* (making a voice an object of the discourse e.g. objectifying teachers by discussing their shortcomings as teachers);

3.4.4 Message and distributing strategies

Distributing strategies link forms of knowledge and practices with particular voices and, together with positioning strategies, they establish subject positions. In the analysis therefore, positioning and distributing strategies will be considered together

[17] By this he means texts which construct a single authorial voice which may be associated with a single activity. This is different from dialogic texts which are interactive texts which may construct two or more authorial voices.
[18] The examples are my own.

to establish dominant and subordinate voices. Knowledge and practices that constitute the message to be distributed, relate to mathematical knowledge, theories of instruction and curriculum innovation practices. Following Dowling (forthcoming), distributing strategies may be described in two categories. The first is associated with the *extent* of knowledge distributed to voices, that is, with the *range* of message distributed to voices. Here I will consider *expanding* strategies (broadening the message distributed to voices in terms of mathematical pedagogic knowledge and in terms of curriculum innovation practices) and *limiting* strategies (narrowing of the message in terms of mathematical pedagogic knowledge and curriculum innovation practices). The second category of distributing strategies is associated with the distribution of either context independent or context dependent practices. Here I will consider *generalising* strategies (distribution of context independent practices) and *localising* strategies (distribution of context dependent practices).

Following this methodology, the analysis set out to establish dominant and subordinate voices in the texts. The analysis was conducted by first examining the individual reports in turn and then looking at message and voice across the reports. It was clear that each report foregrounded different voices and particular message. For example, Report (0-31) foregrounds teacher voices and distributes message relating to the training of mathematics teachers and entails the distribution of mathematical and pedagogic knowledge. In contrast, Report (0-29) foregrounds bureaucratic and academic voices and distributes message relating to mathematical and pedagogic knowledge as well as curriculum innovation practices. However teachers are also mentioned in Report (0-29) and so, in establishing a voice topography the analysis looked within as well as across reports. Chapter 4 discusses positioning and the distribution of message across a range of voices, while chapters 5 and 6 discuss positioning and distribution of message across acquirer and transmitter sub-voices, respectively. In the latter two chapters, acquirers and transmitters are described as textual subjects inscribed within discourses that constitute theories of instruction. Here theories of instruction are understood in Bernstein's (1990: 189) terms as discourses which "regulate the orderings of pedagogic practice, construct the model of the pedagogic subject (acquirer), the model of the transmitter, the model of the

pedagogic context, and the model of the communicative pedagogic competence". In other words, theories of instruction regulate the ordering of pedagogic discourse and determine the modality of practice.[19] In so doing, they constitute specialised pedagogic subjects. In the final analysis chapter I consider the constitution of message in the reports. That is, I consider what has been recontextualised to constitute mathematical knowledge and theories of instruction for school mathematics.

3.5 Conclusion

The theoretical framework for my analysis has been informed by perspectives on the sociology of school knowledge. In particular, the view that curriculum construction is the effect of power-knowledge relations which constitute transmitters and acquirers as subjects inscribed in, and constructed by, social practices and relations. The empirical texts have been located within two fields of practice, namely the ORF and PRF, with an awareness that official pedagogic discourse regulated by the official recontextualising field, will always express dominant principles in society.

The methodology followed in the analysis attempts to point Dowling's (1995) language to curriculum texts. In doing so, school mathematics is defined as a social activity which specialises practices and positions and is (re)produced by human subjectivities and texts. In the analysis of texts, practices and subject positions are realised as message and voice. In the reports, acquirers, transmitters, academics and bureaucrats are voices in the text and message distributed to them relates to the teaching and learning of school mathematics as well as, curriculum innovation practices. Message, in other words, comprises theories of instruction which are constituted through the recontextualising of various discourses. These theories of instruction construct models of transmitters, acquirers, the pedagogic context and pedagogic competence.

[19] Bernstein (1990: 189) distinguishes two modalities of theories of instruction, one that privileges graded performances and the other, shared competencies of acquirers.

Chapter 4

An analysis of voice and message

4.1 Introduction

In the analysis of the reports which follows, I shall attempt to produce a description of their voice topography and the distribution of message across the voice topography. I shall consider textual strategies which position voices and distribute message. I shall use as a principal resource Dowling's (1995) descriptions of positioning and distributing textual strategies. This chapter aims to mark out dominant and subordinate voices in the texts as a way of orientating the reader to the empirical texts. Dominant voices that will be discussed include *bureaucratic*, *academic* and *researcher* voices, while subordinate voices are *teacher* and *learner* voices. Knowledge and practices that constitute message distributed to these voices relate to mathematical knowledge and curriculum innovation practices. The marking out of dominant and subordinate voices in the texts aims simultaneously to position the reports within the field of curriculum production and reproduction.

Report (0-29) discusses innovations with respect to the instruction of mathematics in four European countries and, on the basis of this discussion, makes recommendations for the implementation of some these innovations in SA. In the introduction to the report it is claimed that data was collected through interviews with "[m]athematics teachers, principals of schools, inspectors, administrative education officers, researchers and university lecturers" (Report 0-29: 1). The interviewees could be more broadly categorised into *bureaucratic*, *academicic/researcher* and *teacher* voices. In this discussion I want to illustrate how the authorial voice acts selectively to produce these and other voices into a hierarchy of voices. It is evident that only certain groups speak in an active voice and are strongly identified with the authorial voice, while other voices are objectified and subordinated with respect to the transmission and acquisition of mathematics. I want to illustrate how the authorial voice, that is, the researcher voice, through various positioning and distributing

strategies, positions the academics and researchers as the experts who have generalised knowledge about pedagogic issues like content selection and teaching methodologies, the bureaucrats as the experts in localised knowledge of educational practices and teachers as the experts in localised knowledge of the classroom.

4.2 Dominant voices

Dominant voices here refer to voices which are strongly affiliated with that of the authorial voice. In the preface to Report (0-29) attention is drawn to the fact that while "the researcher is responsible for the factual information, the content of the report and the recommendations contained in it, were approved by the ad hoc committee for research on the instruction of Mathematics in South African schools" (Report 0-29: preface). The authority of this ad hoc committee is established through referencing of the institutional and organisational affiliation of the individuals listed on the committee. Except for one member, the ad hoc committee consists of white males from mostly Afrikaner universities, white education departments and members of MASA. The authorial voice is marked out as that of "the researcher" and is affiliated with the voices of the ad hoc committee with regard to the outcomes of the research. This affiliation establishes the authority of the report, that is, the production of the text is not to be dismissed as the idiosyncratic musings of the researcher, since its contents have been endorsed by a committee of mostly academics from selected universities and officials from selected education departments. In other words, the authorial voice is transformed from an individual voice to a collective voice emanating from two fields of authority: the academic and the bureaucratic fields.

4.2.1 The bureaucratic voice

The recommendations in Report (0-29) explicitly position the bureaucratic voice as a reader voice.

> (a) that in their planning, authorities make provision that the principle of consistent revision of Mathematics syllabuses on the strength of research be maintained;
> (b) that the Joint Matriculation Board make provision for certain schools to be exempted from the final examinations based on core syllabuses in order to make effective evaluation of possible syllabus alterations possible;

(c) that, where at all possible, substantial syllabus alterations in future be implemented after they have been evaluated on an experimental basis in practice;
(d) that for the evaluation of such syllabus alterations, full-time researchers be appointed, and serving teachers be involved.

(Report 0-29: 48, emphasis in original)

Here "authorities" are directly addressed; they are the ones who can make provision for the revision of syllabuses, who can exempt certain schools from final examinations, who can make decisions about when syllabus alterations should be implemented and who can appoint full time researchers. The recommendations come at the end of the report and are based on the discussion in the report of innovation programmes in selected countries. The discussion revolves around difficulties and triumphs of bureaucratic structures in the selected countries to implement innovation programmes. I will relate some of this discussion here in order to show the bureaucratic voice as a *displaced* authorial voice.

Report (0-29) is organised in such a way that chapters 2-5 are dedicated to separate descriptions of mathematics curriculum innovations and their implementation, in four European countries, namely, Netherlands, Belgium, England and West Germany. Each chapter is characterised by descriptions of bureaucratic structures[1] and procedures for the implementation of change in a specific country. A motivation given for this structure relates to differences between the school systems of the various countries:

> In order to evaluate particular organisational forms for innovation with a view to recommendations concerning the innovation of Mathematics instruction in South Africa, it is necessary to evaluate such organisational forms every time against the background of the school system in which it is implemented (Report 0-29: 2).

The different chapters are thus presented as descriptions of localised conditions, conditions relating to the organisation and bureaucratic control of schooling, administration of examinations and organisation of innovation programmes, which are either seen to inhibit or facilitate the implementation of curriculum innovations in that

[1]In the Netherlands it is the Commissie Modernisering Leerplan Wiskunde (CMLW) and the Instituut voor Ontwikkeling van het Wiskunde Onderwijs (IOWO); in Belgium, the Belgian Centre for the Methodology of Mathematics Instruction (BCMW), in England it is the Schools Council and, in West Germany it is the Standigen Konferenz der Kulturminister (SKK) and Deutsche Bildungsgrat and

country. Bureaucratic structures are produced as necessarily contributing to such conditions. The bureaucratic voice is recruited and positioned as the provider of the necessary infrastructure for the implementation and success of innovation projects. For example, England is distinguished from the other countries as having a decentralised system of control over examinations. As such, the report concludes that

> [F]rom the nature of the case it is easier to evaluate experimental syllabuses practically, since in any case there is a variety of different final examinations for every subject, and the presentation of a special final examination for pupils who follow experimental syllabuses, creates no problem. In countries with centralised control over examinations, such as the Netherlands, it was necessary to exempt schools in which experimental syllabuses were followed from the normal final examinations (Report 0-29: 46).

Here, the organisation of bureaucratic structures into centralised or decentralised systems and the subsequent degree of control which they have over schools are two aspects which are marked out as factors which inhibit or support the implementation of innovations. England is identified as a special case with a decentralised system of education where there is little direct regulation over contents of school syllabuses. It is argued that within such a system it is easier to trial new ideas in schools and, by implication, innovation initiatives are more successfully implemented. There is the suggestion that, if such a system is not in place, implementation of innovation would be more limited. However, the example of the system in the Netherlands is used to illustrate how bureaucratic structures, limited by a centralised system, supported innovation by exempting experimental schools from centralised examinations. In effect, the researcher is able to show that both systems (centralised and decentralised) are viable for the implementation of innovations.

In further descriptions, bureaucratic structures in the different countries are "shown" to set up or facilitate the work of commissions and projects assigned to design new syllabuses and to co-ordinate in-service courses for the retraining of teachers. In the description of the Netherlands it is the CMLW, a commission of the state which eventually leads to the formation of the IOWO at the university of Utrecht, which is seen to take responsibility for the centralisation of innovation activities in the country. In West Germany the SKK and Bildungsgrat are credited with setting up a

subcommittee on curriculum development to co-ordinate the design of new syllabuses. The description of Belgium suggests that it is only through the establishment of the BCMW by the state that work groups could be established with the aim of "re-orientating Mathematics teachers with regard to modern Mathematics"(Report 0-29: 32). Bureaucrats are thus positioned as local managers with organisational and facilitative responsibilities for curriculum innovations. They are positioned as the ones who provide the infrastructure for innovation projects to be implemented and to succeed. For example, the report describes the tasks and achievements of the CMLW, a commission brought into being by the Minister of Education in the Netherlands:

> From 1963 to 1966 all Mathematics teachers (secondary schools) attended in-service training courses. During the period 1964-1968 "experimental" syllabuses were implemented at various gymnasia. These schools were exempted from the normal final examinations and the pupils sat for special examinations based on the "experimental" syllabuses. New Mathematics syllabuses for secondary schools were introduced in 1968. These new syllabuses were composed in accordance with the results of the implementation of "experimental" syllabuses during the 1964-1968 period (Report 0-29: 4)

Here we see the establishment of a government commission, a commission dedicated to the implementation of curriculum innovation, which, over the space of five years, with the support of the state, could co-ordinate in-service training courses, could trial syllabuses, could exempt trial schools from normal examinations, had time to evaluate trial syllabuses and could produce new syllabuses. In other words, with supportive bureaucratic structures, successful implementation of curriculum innovations is always possible. There is a suggestion that if this commission were not formed perhaps less would have been achieved.

In these descriptions the authorial voice expresses empathy with the bureaucratic voice by describing the many difficulties which bureaucrats, working in centralised systems of education, had to overcome. Empathy between the authorial voice and this reader voice, positions the bureaucratic voice as a *displaced* authorial voice. In Dowling's (forthcoming) terms, *displacement* is achieved when the authorial voice identifies with the reader voice "by claiming empathy with the reader's difficulties". Through its lengthy descriptions of local practices in each country, the authorial voice

identifies with the problems bureaucratic structures experience in the management and facilitation of implementing innovation programmes. As providers and facilitators of the infrastructure, the bureaucratic voice is produced as dominant with respect to the implementation of innovation programmes.

It may also be argued that the selection and description of bureaucratic structures is an attempt to map out the structuring of official pedagogic discourse in the different countries. That is, they describe "official rules regulating the production, distribution, reproduction, interrelation and change of legitimate texts (discourse), their social relations of transmission and acquisition (practice), and the organisation of their contexts (organisation)" (Bernstein, 1990: 193). The bureaucratic voice is recruited only to describe bureaucratic procedures for the implementation of change. They do not deliver commentary on pedagogic discourse of reproduction, that is, classroom practice. For example, the following is a summary of the description given of the method of work with regard to curriculum development of the IOWO in the Netherlands:

- firstly, "experimental" study material (textbook and other aids) are designed on the basis of one person collecting draft material, which is then evaluated by colleagues. On the strength of this evaluation, alterations are made where necessary.
- secondly, these materials are implemented in a "design school" and are evaluated and refined by IOWO staff in co-operation with the teachers of the "design school". Teachers of these schools are trained by IOWO staff on the strength of weekly lectures and discussions of the "experimental" materials. IOWO staff also attend classes and teach some lessons. On the basis of these experiences the study materials and teacher guides are revised.
- the third phase sees the revised materials used as study materials for voluntary inservice courses for teachers as a way of introducing more teachers to the "new" curriculum units. These courses are aimed at re-orientating teachers with a view to future innovation throughout the country.
- finally, a working group at the IOWO works on integrating the new subject-matter and method of presentation with existing syllabuses and methods of integration, thus forming an "integrated" curriculum which may serve as a basis for innovation throughout the country. (Report 0-29: 8-9)

Similar details are given for the *institutes of subject didactics* in Germany, the *Nuffield* and *SMP* projects in England and the *BCMW* in Belgium. The bureaucratic voice, as the displaced author, offers procedures for implementing curriculum changes and suggests that any programme of curriculum innovation will succeed only if it is properly managed and implemented in a particular way, i.e. if the proper procedures are followed. Knowledge and practices which are distributed to the bureaucratic voice

thus centre on knowledge of local practices relating to administration of schooling, administering of examinations, evaluating syllabuses, co-ordinating in-service programmes, facilitating materials development and managing strategies for implementing innovation programmes. With respect to the implementation of innovation programmes, the range of the message is expanded in that knowledge from a range of activities relating to the implementation of innovation is distributed to the bureaucratic voice.

However, recommendation (d) above which states that "for the evaluation of such syllabus alterations, full-time researchers be appointed, and serving teachers be involved", suggests that with respect to mathematical and pedagogic knowledge, the range of message distributed to the bureaucratic voice is limited. The "authorities" must appoint "researchers" and "serving teachers" to evaluate mathematics syllabuses, rather than take on such a task themselves. Their field of expertise lies outside the domain of mathematics. Mathematics is merely one of several curriculum innovation programmes which bureaucrats manage and implement. Bureaucratic structures are produced as structures which establish spaces for activities relating to curriculum innovation. On the basis of the recommendations of Report (0-29) cited above, we may argue that the bureaucratic voice is recruited to establish a legitimate space for research activity as part of the procedures for implementing curriculum innovations. Recommendation (a) suggests that syllabuses be revised "on the strength of research", and recommendation (b) and (c) refer to "evaluation" of syllabuses, which again implies research, and (d) explicitly suggests the appointment of "full-time researchers" to evaluate syllabuses. Through these recommendations, new spaces for research and development activities are produced and they suggest that curriculum innovation programmes cannot be wholly successful without some research. In other words, the displaced author, the bureaucratic voice, is produced to establish a legitimate space for the voice of the researcher. In doing so, the text establishes a legitimate space for its own production, which is classified as research. The researcher voice is produced as central to the process of curriculum development. In particular, the researcher voice is produced as one which contributes to the mathematical and pedagogic knowledge necessary for curriculum development.

In summary, we may argue that the bureaucratic voice is positioned as dominant, becoming a displaced authorial voice, with respect to the organisation and implementation of curriculum innovation. In relation to this we have the distribution of localised practices with expanded range of message. At the same time, the bureaucratic voice is positioned as subordinate with respect to mathematical and pedagogic knowledge and is recruited to establish a legitimate space for the voice of the researcher.

4.2.2 The academic voice

While in each chapter of Report (0-29) bureaucrats are seen to take on most of the organisational and facilitative responsibilities for curriculum innovations, the academics are seen to conceptualise and lead innovation projects. In other words, academics are involved in the running and management of innovation programmes which are only made possible by infrastructure provided by the support of bureaucrats. Academics are thus positioned as subordinate to the bureaucrats with respect to the "organisation of innovation", that is making such programmes possible in the first place. They are seen to lead the commissions and the innovation projects, providing expertise in mathematics education and adopting particular methodological approaches, but in most cases they remain accountable to some bureaucratic structure. They are positioned as dominant in relation to bureaucrats with respect to mathematical and pedagogic knowledge. The dominance of academic voices are also established through strategies of affiliation with the authorial voice. The authorial voice affiliates with academic voices which are recruited in the text to comment on mathematical contents of syllabuses and teaching methodologies.

There is strong affiliation with selected professional mathematicians and mathematics educators who are quoted at length and are active voices in the texts. For example, we have Professor H. Freudenthal, described as "the director of the IOWO in the Netherlands" and as a "world famous group theorist" who is quoted several times for

his views on the contents of mathematics syllabuses and the way these should be taught and learned:

> If children are taught groups they are entitled to learn genuine group theory rather than a childish version (Freudenthal in Report 0-29: 39)
> [...]
> In principle it is a healthy idea not to teach isolated pieces but coherent material. Connected matter is faster learned and longer retained.....While I do not urge that the pupil learns applied mathematics, I do wish that he learns how to apply mathematics. This does not mean utilitarianism. Therefore instead of applied mathematics, I would prefer to speak of multirelated mathematics (Freudenthal in Report 0-29:39)

There are also frequent quotations from Ormell, described as the director of the SFMP[2], Lighthill, the director of ICME[3] at the time and Thom, "a distinguished contemporary mathematician" who delivered a paper at ICME:

> [R]eformers ...have been induced,.....on the one hand to abandon that terrain which is an ideal apprenticeship for investigation, that inexhaustible mine of exercise, Euclidean geometry, and on the other hand, to substitute for it the generalities of sets and logic, that is to say, material which is as poor, empty and discouraging to intuition as can be (Thom in Report 0-29: 40);

> As in all teaching, motivation is the key factor. If we can get this right there is some hope of getting the system to work in a fruitful way for student, teacher, tertiary lecturer/teacher and employer alike. The most natural way to create motivation is to let the subject speak for itself: to show what it does and can do (Ormell in Report 0-29: 36)

> My personal emphasis in this message is on those aspects of mathematical education that are concerned with communicating a working knowledge of how mathematics interacts with other subjects and with the external world; in one word, a knowledge of how mathematics is applied (Lighthill in Report 0-29: 37)

It may be argued that these academic voices have been selected because they share common views critiquing the "modernisation" of syllabuses in the 1960s[4]. They express a common concern that mathematics should be made more meaningful for students by proposing that syllabus contents be made less abstract and that more connections be made in syllabus contents with other aspects of students' daily lives. The authorial voice recruits these academic voices as experts on mathematics and

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[2] Sixth Form Mathematics Project, in Britain.
[3] International Conference for Mathematics Education
[4] This entailed that "the formal-conventional characteristics of mathematical systems were identified and described on the basis of abstract concepts such as sets, relation, group, metrics etc (Report 0-29: 35).

mathematics education to motivate for a curriculum which is "relevant" and which presents students with everyday or non-mathematical problem situations which "may lead [them] to independent design of the mathematical model required by the problem situation" (Report 0-29:27). A curriculum which teaches pupils "how to apply mathematics" without the notion of "crass utilitarianism" (ibid). The authorial voice affiliates with these academic voices by endorsing their views and suggesting that the critiques they offer are valid for the current (1970's) South African syllabuses:

> The foregoing quotations are probably adequate to indicate that West European mathematicians and Mathematics didacticians at present very much doubt the didactical-pedagogical accountability and effectivity of the initial attempts at innovation (which gave direct cause to the present (new) South African Mathematics syllabuses for the primary and secondary school). It is therefore also noticeable [..] that more recent attempts at innovation such as the Sixth Form Mathematics Project, the Mathematics for the Majority project and the projects undertaken by the IOWO Institute in the Netherlands, break away radically from mathematical modernisation which has become traditional (Report 0-29: 40).

It is clear that by affiliating with these views, the authorial voice establishes its authority to assert the need for innovation of mathematics syllabuses in South Africa and the form such innovation should take. Ultimately these assertions are consistent with the views of the academic voices which are recruited. The voice of the mathematics educator is also recruited to comment on the participation of teachers in curriculum development. For example, the report cites from an ICME working group report:

> It is naive to define curriculum as the content of a textbook, or its development as the introduction of a new one. It is both more realistic and more constructive to define curriculum as what actually takes place in the classroom. This immediately gives the teacher a key role in curriculum innovation. Many developing countries are already acting on this principle, by giving teachers a major share of responsibility for developing new materials, and by recognising their crucial role in the evaluation of them in the classroom (ICME Working Group in Report 0-29: 44)

Here again there is the recruitment of the active academic voice. The authorial voice affiliates with this academic voice, stating that "there seems no reason to doubt the validity of the foregoing verdicts" (ibid: 44) and goes on to recommend for example that serving teachers *must* be involved in the evaluation of syllabus alterations. In other words, the involvement of teachers in curriculum development processes is one based on the sound views of mathematics educators, not merely those of bureaucrats

who benefit from teachers' co-operation in the implementation of innovation programmes.

Descriptions of innovation programmes in the Netherlands provides more illustrations of the hierarchical positioning of academic and bureaucratic voices. There, the CMLW is the bureaucratic structure which initially set up subcommissions to draw up new syllabuses and to co-ordinate retraining of teachers. These functions were then taken over by the IOWO, an institute at the university of Utrecht. In other words, the co-ordinating and running of curriculum innovations was taken over from the bureaucrats by the academics. There is a conscious effort in the text to establish the legitimacy of these academics:

> In the planning and implementation of innovation, the view is held at present that the first concern is to widen and deepen the educational value of Mathematics instruction and not to promote Mathematics as a subject. This point of view is strongly propounded by Prof. H. Freudenthal, the present director of the IOWO, in his recent book Mathematics is an educational task (Report 0-29: 5)

The authorial voice affiliates with the voice of this "Professor", that is, it claims to express a view that is also "strongly propounded" by the professor. There also seems to be a suggestion, with the reference to "the educational value of mathematics" that the shift of responsibility from the bureaucrats to the academics carries with it an educational accountability which bureaucrats cannot meet. Consider the discussion on England and Wales, in which Ormell, the initiator and director of the Sixth Form Mathematics Project, is quoted at length on the "didactical assumptions" of that project:

> ....although the aesthetic-formalist approach may foster sensibility, the sensibility it fosters tends to be of the ivory tower' variety. This approach may please (some) pure research mathematicians in the universities, but it is unlikely to satisfy those who have a larger conception of the place of mathematics in education, or who hope to employ graduates usefully on practical tasks.....[t]he value of an approach which lays stress on relevance is that it connects mathematics with other studies and with the main stream of human preoccupations and concerns.... (Report 0-29: 26).

The SFMP is positioned as an opposition to innovation projects of the sixties which emphasised the formal structures in mathematics. What seems to mark out this

project is its sensitivity to "a larger conception of the place of mathematics in education". Here the expert in mathematics education is distinguished from the expert in research mathematics, the latter being positioned subordinately in terms of mathematics education. The authorial voice thus affiliates only with academics who stress the applied aspects of mathematics since, it is implied, this reflects a broader conception of mathematics education. This same position is reflected in some of the earlier extracts by Freudenthal and Lighthill, which effectively positions all of them as experts in mathematics education by virtue of their emphasis on the relevance of mathematics to other aspects of pupils' lives. By affiliating with these academic voices, the authorial voice affiliates with the experts in mathematics education.

In the chapter on West Germany, the SKK and Deutsche Bildungsgrat are the bureaucratic structures which advise the state and which also set up a subcommittee for curriculum development in order to initiate "innovations in mathematics instruction". It is the chairman of this subcommittee who is the only person quoted in this chapter:

> According to Prof. Bauersfeld, the present chairman of the committee, experience over the past 10-15 years in West Germany showed that prescribing new syllabuses, even if it should be accompanied by the making available of new textbooks and orientation courses for teachers, is not an effective way of innovation. According to him it is essential that teachers should actively participate in the "development" of new curricula, in order to guarantee that they will effectively implement such criteria". (Report 0-29: 17)

Again it is the academic who speaks. The authority of the speaker is established by virtue of him being a professor and one who is seen to have many years experience of education in West Germany. In this extract though, the expert is not commenting on the selection of contents but rather on effective ways of implementing innovations. In particular, he is commenting on the participation of teachers in the curriculum development process. In other words, the academic voice is also allowed to speak on *procedures* for implementing changes, not only on the contents of syllabus changes.

It is clear that the academic voice is recruited as an expert with generalised knowledge of mathematics and pedagogy. This generalised knowledge also enables the academic

voice to comment on procedures for implementing curriculum innovations. In contrast to the bureaucratic voice, the academic voice is not context bound. The range of message distributed to the academic voice is expanded with respect to both mathematical knowledge and curriculum innovation practices. Affiliation between the authorial voice and active academic voices, positions them as dominant in the text. The effect of direct speech is that the impact of recontextualising is apparently minimised. The academic voice is seen "to speak" for itself. The authority of academic voices is established through their own credentials: they are professors, they write books, they attend and deliver papers at international conferences on mathematics education and so they can speak about mathematics, mathematics content selections for syllabuses, suitable teaching methodologies and procedures for implementing syllabus alterations. The credentials of the academic voice to which the authorial voice affiliates also establishes the authority of the text.

4.2.3 The researcher voice

The authorial researcher voice affiliates with academic voices to establish its own authority. Through the displaced authorial voice (with the bureaucratic voice), the researcher voice becomes an imperative voice - it makes recommendations with regard to the organisation, transmission and acquisition of school mathematics; it formulates aims and objectives for the teaching and learning of school mathematics and, it consistently preserves a space for itself.

The dominance of the authorial researcher voice is produced through the claiming of both generalised and localised knowledge. The researcher, through his affiliation with academic voices, has generalised knowledge of mathematics and mathematics education. Through displacement with bureaucratic voices associated with practices in various countries, the researcher voice also has generalised knowledge of procedures for implementing curriculum innovations. In addition, the researcher voice is able to comment on local (SA) educational practices relating to administration of schooling as well as syllabus contents. The range of message distributed to the researcher is expanded. In other words, the researcher voice can comment on both

general and local practices relating to transmission and acquisition of mathematics, as well as general and local procedures for implementing curriculum innovations.

4.3 Subordinate voices

These are voices which are objectified and realised as dependent voices in the text. That is, they are dependent on other voices for the distribution of message. The subordinate voices here are those of teachers and learners. Objectification of teacher and learner voices is achieved by making teachers and learners objects of discourse. As such we have discussions of teachers' shortcomings, of teachers' and learners' needs and aspirations and, suggestions of how teachers' and learners' behaviour may be changed, that is, how teachers could teach differently and how learners could learn differently.

4.3.1 Teacher voices

Teachers are objectified in the reports by discussions of their shortcomings, their practices, their knowledge, their training and their qualifications. Teachers are positioned as objects of metadiscourse, meaning that the researcher, academic and bureaucratic voices are heard expressing their views on what teachers should and should not be doing or what knowledge they should or should not have. The following extracts refer to teachers' shortcomings:

> Possibly one of the greatest shortcomings of Mathematics teachers is that they do not realise what sense and meaning Mathematics can and should have for their pupils and consequently the teaching of Mathematics has degenerated to the mere reproduction of so many tricks (Report 0-31: 4)

> [T]eachers do not always know why certain topics are taught in Mathematics, or even that they do not know at all why Mathematics is still taught (Report 0-44: 8).

It is the researcher voice who recognises teachers' shortcomings and which can recommend ways (through teacher training courses) of overcoming these shortcomings. The objectified teacher voice does not "speak" for itself and so it is positioned as a subordinate and objectified voice. The authorial researcher voice is the authoritative voice on teachers' knowledge and practices. It is the voice which

makes suggestions of what knowledge teachers should have in order to be effective practitioners:

> Prospective secondary school Mathematics teachers especially should, for instance, see how Cantor's work on sets came about as a result of his study of the Fourier series, how Hielbert's study of spaces resulted from his work on integral equations, while Topology came to the fore as a result of Riemann's study of areas and integration over complex numbers. [...] A Mathematics teacher with such an insight into Mathematics will surely not present his lessons as a series of recipes and techniques which have to be applied to specific types of problems (Report 0-31: 4).

> The Mathematics teacher must have a pedagogically and didactically sound training. He [sic] must have clearly defined aims when he stands in front of his class. His preparation must be based on didactical considerations so that situations are mathematized and the pupils can approach the subject intuitively instead of being burdened with countless exercises (Report 0-31: 5).

Teachers are positioned as subordinate to the authorial researcher voice. That is, it is the researcher voice that comments on what training and knowledge teachers should have and prescribes practices to them. In the above extracts teachers are also positioned as subordinate to the academic mathematician voice, that voice which has insight into the work of mathematicians like Cantor, Fourier, Hielbert and Riemann. Teachers are positioned as acquirers in relation to academics and researchers; teachers must learn from them and take heed of what they say with regard to mathematics teaching and teacher training. In the objectification of teacher voices, the reports differentiate between primary and secondary teachers and discuss "peculiarities" for each category. For example, primary teachers are produced as lacking in self confidence and so Report (0-31: 270) recommends that mathematics courses for primary teachers be spread over the full duration of the training course:

> Should the Mathematics courses be spread over the first two years of the [training course], it is conceivable that a teacher taking up his/her first appointment will be less confident in those subjects in which he/she did no work in the previous year, that is the final year of his/her diploma.

Secondary teachers are produced as inexperienced in applying their mathematical knowledge:

> At present, a prospective [secondary] teacher usually undertakes the study of Mathematics at university or college and then he starts teaching the subject without ever having had experience of using it (Report 0-31: 272).

The experience that seems lacking in secondary teachers is described as "the ability to make mathematical investigations" and so a dual stream mathematics course is recommended for the training of secondary teachers which would include academic and practical (applied) mathematics courses. I will consider in a later chapter, positioning and distributing strategies for the hierarchising of teacher sub-voices. The authorial voice does not affiliate itself to the teacher voice, it objectifies it and presents it as a topic for discussion. The objectified teacher voice is produced as a dependent voice, dependent on knowledge and expertise of the academic and researcher voices.

I want to consider now how the objectified teacher voice is positioned, on one hand, as subordinate to the researcher, academic and bureaucratic voice with respect to the production of pedagogic knowledge and on the other, as dominant to the learner voice with respect to knowledge production within the pedagogic context.

(a) Teachers as reproducers of pedagogic discourse

With respect to the construction of curriculum knowledge, teachers are positioned as subordinate to curriculum developers (academics and researchers) and bureaucrats. Curriculum developers and bureaucrats are seen as those who define and legitimise official pedagogic discourse, that is, they define what is to be taught and how. Teachers, are produced as the reproducers of pedagogic discourse, that is, they reproduce, in the classroom context, what has been defined as official pedagogic discourse. They teach the contents, follow the sequencing and adopt the teaching methodologies that are prescribed in official syllabuses and textbooks:

> Didactically speaking it is on the basis of the classroom activities, as designed and initiated by the teacher, that the aims of Mathematics instruction are pursued and realised. However, the teacher plans the activities within the framework and therefore with consideration for a didactical-organisational structure subdivided into various facets, namely:
> (a) The formulation of aims of mathematics instruction by the responsible bodies.
> (b) The composition of Mathematics syllabuses.
> (c) The composition of textbooks.
> (d) External examining.
> (e) Training of teachers.
> (f) Control and advice by the inspectorate.

> The formulation, composition or furtherance of the above-mentioned educational aspects are the responsibility of specific persons or groups of persons (Report 0-13: 21).
>
> [T]he classroom activities have to follow a particular course in order to make the realisation of aims possible. It is therefore the task of the teacher to design and initiate these activities in such a manner that the forementioned and other potential conditions for the actualisation of aims of Mathematics instruction are satisfied (Report 0-13: 27).

While the teacher here is seen to be in control of the pedagogic context through the design of classroom activities, the teacher is still crucially, a *reproducer* of pedagogic discourse - the teacher reproduces the aims of mathematics instruction formulated by others, is bound by the constraints of syllabuses, textbooks and external examining and is subject to surveillance/regulation by the inspectorate. The teacher is accountable for the design of his/her classroom activities to the *producers* of pedagogic discourse and those who legitimise the discourse i.e. the curriculum developers (academics), textbook producers and the educational bureaucracy. There is limited expectation that the teacher would use his/her own initiative in terms of the arrangement of contents, pace and emphasis of lessons:

> Although it cannot be accepted that the officially formulated aims are purposefully and effectively pursued by all Mathematics teachers, it is probably justified to assume that their official formulation is directive in respect of the pursuance of aims in the teaching situation (Report 0-13: 22).
>
> Although the teacher has a degree of freedom in respect of the planning and actualisation of the classroom activities, it is obvious that in respect of methodological aspects such as arrangement of subject matter by presentation, pace of presentation and emphasis of particular aspects of the learning contents, he will to some degree take into consideration the composition of the textbook which is in use (Report 0-13: 23).

There is an assumption here of an "official" textbook, "the one in use", which teachers are expected to use and which presumably, prescribes to some extent the sequencing and pacing of lessons which teachers are to follow. In other words, while there is the recognition of the control the teacher has over activities in the classroom and perhaps the potential for official aims of mathematics instruction to be undermined in classroom activities, teachers are constructed as having limited autonomy with respect to the sequencing and pacing of lessons and the pursuance of aims in mathematics instruction. Their activity in the classroom is regulated by prescriptions in syllabuses and official textbooks.

There are also suggestions in the reports that teacher training courses may further regulate teacher activity in the classroom by promulgating the aims and objectives of the official pedagogic discourse, that is, the "necessary perspective on the nature and significance of the subject":

> It is essential, inter alia, that the training of Mathematics teachers makes provision for them to acquire the necessary perspective on the nature and significance of the subject, which is a condition for its successful and meaningful instruction. By its nature the mathematical (academic) as well as subject didactical (professional) training should contribute towards this (Report 0-13: 23, emphasis in original).

In other words, teachers are to be *trained* in the *relay* of knowledge; they are to become reproducers of knowledge. Teachers are not expected to interpret knowledge and acquire their own perspective on the subject they teach. Their training must include academic as well as professional knowledge, which will both contribute to the "necessary perspective on the nature and significance of the subject". Teachers are produced as subordinate to the academic and professional voice with respect to their perspectives on the nature and significance of mathematics. They must take on the perspectives offered in their training courses and in official documents like syllabuses and official textbooks.

The range of message with respect to mathematical and pedagogic knowledge distributed to teachers is limited. Training courses prepare teachers to be relayers of knowledge by providing them with procedures for structuring lessons. For example, Report (0-31: 278) provides a scheme for the structuring and progression of a lesson which teachers should follow:

> 1. The form of the lesson: In his preparation a teacher must decide on -
> (a) a basic didactical form (play, conversation and/or task);
> (b) a methodological principle (inductive, deductive);
> (c) an arrangement of the subject matter (linear, concentric, chronological, etc.) and
> (d) an approach whereby the essential meaning of the new topic is brought home to the pupils whose eagerness to learn has been awakened by confronting them with the new subject matter in a problem situation.
>
> 2. The progression of the actual lesson: This consists of -
> (a) motivating the pupil to apply his pre-knowledge;
> (b) confronting the pupils with a problem connected to their experience;
> (c) exposition of the new subject matter in relation to the problem;
> (d) controlling to make sure that essence of the new subject matter has been grasped by the pupils;

(e) allowing the pupils to apply their new insight to related problems, and
(f) evaluation.

This scheme is presented as an aid to assist teachers in "the responsible pruning of superfluous subject detail in order to concentrate on the essentials" (ibid: 277). The "essential" knowledge that teachers should have concerns only the structuring and progression of a lesson. There is no reference to the elaboration of general pedagogic principles that informed the structuring of the scheme. In this sense, the range of message with respect to pedagogic knowledge is limited. The range of the message is also limited with respect to the mathematical knowledge distributed to teachers. For example, there is a recommendation that "a more school-orientated Mathematics course for prospective secondary teachers" (ibid: 272) be introduced and there are consistent references to mathematics courses which must "fulfil the needs of mathematics teachers". It is clear that such courses are not equivalent to academic mathematics courses since Report (0-31: 274) suggests that

> A student who has, for example, successfully completed the school-orientated Mathematics courses to second-year level, could be accredited with first-year degree Mathematics and for instance two "modules" of the second-year degree courses.[5]

In other words, mathematics courses for teachers are of a lower academic standard than degree mathematics courses. In this sense then the range of message distributed to the teacher voice is limited.

(b) Teachers as regulators/organisers of the pedagogic context

While the above section shows that teachers are produced as having limited autonomy with respect to the production of pedagogic discourse, teachers are constructed as the primary regulators of the pedagogic context:

> [S]ince ways of "learning to know" are indeed initiated by the teacher, the latter has the unquestioned responsibility for the ways in which the learning process is accomplished. Put briefly, on the one hand there is talk of a methodological approach to the instruction which may lead to an uncomprehending manner of knowing and on the other, an approach which results in "knowing conceptually". [...] Fundamentally the task of teacher remains to suggest methods of learning (Report 0-13: 25).

[5] "Student" refers here to "student -teacher"

Thus, in the classroom context, the teacher, rather than the students, are seen to control "ways of learning", as well as what gets learnt. There is an assumption here that teachers *can* suggest "methods of learning", that this is something the teacher *can* regulate. Teachers are produced as being at the centre of the pedagogic context. They control what students need to know, how students learn and what meaning students attach to mathematics:

> [T]he teacher, in view of the inevitable heterogeneousness of the Mathematics class, will have to ensure every time whether the class has adequate learning readiness, and whether he [sic] will have to give additional instruction (do revision) if necessary. Such supplementary instruction need not necessarily be directed towards the mastery of mathematics learning contents, but may especially be of importance with a view to the significance which children attach to already mastered contents (Report 0-13: 26).

> [T]he pupil will not proceed to learning, unless the contents have some significance for him [sic]. It is therefore the teacher's inescapable task to lead pupils towards attaching significance (however preliminary, fluid or diffuse it may be) to learning contents, before they are confronted with its full depth and scope (Report 0-13: 26).

> [C]hildren have to be guided towards interpretation of particular kinds of situations in which the handling of quantitative aspects is of importance, before they are instructed in the relevant Mathematics subject contents (Report 0-13: 29, emphasis in original).

The teacher must thus be able to assess his/her students, not only with respect to what they know, but also with respect to how they know, that is, what "significance" they attach to the mathematics. The teacher here is expected to regulate not only content knowledge of students, but also the "meaning" attached to this knowledge. We have here the distribution of localised (context dependent) knowledge to the teacher voice; knowledge of local classroom contexts, for example, knowledge of their students' abilities to attach significance to learning contents. Teachers are produced as regulators of both intellectual and affective aspects of students' learning. In addition, teachers are expected to "lead" children towards "the acquisition of perspective on reality" as well as "perspective in respect of the demands which are made in different vocational sectors in respect of mathematical competency" (Report 0-13: 25). In other words, the teacher, through the design of classroom activities and control of the pedagogic context, must prepare the child for adulthood and the demands that go with it. Teachers are thus produced as having full control over the thoughts and actions of

their students. The teacher voice is thus positioned as dominant in relation to the learner voice within the pedagogic context. The learner voice here is produced as a dependent voice.

(c) Teachers as objects and instruments for change

Finally, the objectification of the teacher voice, positioned as both reproducer of pedagogic discourse and regulator within the pedagogic context, is further achieved through the production of teachers as both objects of change and instruments for change. For example, with respect to the "organisation of innovation", Report (0-29), draws on the experiences of five Western European countries to assert that:

> Persons involved with innovation and with whom interviews were conducted, without exception agree explicitly that the active, productive participation of serving teachers in the designing of new syllabuses, is an essential condition for effective syllabus innovation. It is noticeable that innovation projects in which serving teachers had been involved from the beginning, until now have apparently been more successful than others (Report 0-29: 42).

> The present Western European approach to innovation of Mathematics instruction is therefore that teachers' participation and practical evaluation, supported by the services of full-time planners, are the only really effective manner of innovation (Report 0-29: 47).

Consequently, we find recommendations and procedures for the recruitment of teachers into (new) curriculum development and materials development initiatives. In other words, teachers are recruited into curriculum innovation programmes because of their local knowledge of classroom contexts. The participation of teachers in such initiatives, are seen as a way of ensuring teachers' co-operation in the implementation of "innovation programmes" (ibid: 42). That is, if new curricula are to be introduced, teachers should buy into the new ideas so that they can implement them effectively. As such, teachers are produced as both *objects of change* and *instruments for change*. Hence we also find recommendations and procedures for the retraining of teachers as part of the procedures for implementing innovation programmes. In other words, if "innovation programmes" are designed to effect new pedagogic outcomes for students, then teachers must be the objects of change, that is, they must be retrained. Retraining assumes that changes in teachers' perspectives on their teaching will occur. Within the classroom context, teachers are produced as reproducers of discourse and

regulators of the pedagogic context and as such, with the desired changes in perspectives, they may effect the desired pedagogic outcomes of the "innovation programmes".

4.3.1.1 Summary

The teacher voice is objectified and produced as a subordinate voice in the text. Localised knowledge, that is, context specific knowledge, with limited range of message is distributed to the teacher voice. The objectified teacher voice is the expert on local conditions in the classroom, but is only a relayer of knowledge. The range of the message is limited to what teachers need to know in order to teach effectively. Essential knowledge for teachers is primarily recontextualised knowledge, that is, knowledge which has been recontextualised for teaching school mathematics. It is not seen as necessary, for example, that mathematics teachers should be apprenticed to the esoteric practices of mathematicians. They are to be taught only the rules of mathematics that pertain to the teaching of school mathematics. The teacher voice is positioned as subordinate to the authorial researcher, academic and bureaucratic voices, and is dominant in relation to the learner voice. Within the category of teacher voice we also find a hierarchical positioning of subvoices. Positioning and distributing strategies for this hierarchical arrangement of subvoices will be discussed in more detail in Chapter 5.[6]

4.3.2 The learner voice

It is apparent in the reports that there are a number of sub-voices, related to the learner voice, which may be hierarchically positioned, but this will be conducted in a later chapter. The purpose here is simply to position the learner voice in relation to other dominant and subordinate voices in the text. The learner voice is an objectified voice and is effectively positioned as the most subordinate voice in the text. Objectification of the learner voice is achieved through discussion of peculiarities relating to learner needs, aspirations, abilities and dispositions. For example,

[6] That chapter attempts to link the hierarchising of subvoices to the production of theories of instruction which construct models of transmitters and pedagogic modalities of practice.

> [C]hildren are inevitably dependent on the educational assistance of adults, that is, since particular demands are made upon adults, which, of necessity, children are unable to meet (Report 0-13: 6).

> When the adult is making these contents available to the child, he [sic] takes into consideration that a child is not at all times ready or ripe or receptive for such contents, and the adult varies his presentation of contents in accordance with the readiness of the child to master and control them (Report 0-44: 24).

> Every child is created as a separate individual, non-recurring, never to be repeated, unique and therefore unequal. This inequality or individual otherness of child to child is clearly visible at the time of their first entry to the primary school when they are formally confronted for the first time with syllabus contents, where they show significant differences in respect of matters such as language control and school readiness (Report 0-44: 30).

> Pupils in any case do not have the same abilities for logical and abstract thought and certain subject-matter contents with different degrees of difficulty will obviously be more difficult or more complex for some than others. There must consequently be such selection that the degree of difficulty corresponds with the pupils' abilities (Report 0-44: 36)

As an object of meta-discourse learners become a topic for discussion. The learner voice is produced as a dependent voice which is subordinate to the dominant voices in the text as well as the other objectified voice in the text, namely the teacher voice. We also have the suggestion here of multiple learner voices corresponding to pupil abilities. The range of message with respect to mathematical knowledge distributed to the learner voice varies across subvoices. For example, Report (0-44) suggests that the selection of contents and therefore the knowledge to be distributed to learners is primarily affected by the "learning tempo" and "learning readiness" of pupils rather than a consideration of what mathematical knowledge, in general, pupils of mathematics should have access to:

> The syllabus compiler therefore does not prescribe any content at any time, but based on his knowledge of the child he anticipates the child's potentialities to master a specific subject-matter extent within a particular time. At a time when he judges to be correct, id est at a time when the child is ready for it, he prescribes certain contents which he, to the best of his ability, considers essential and important at that time (phase of life) (Report 0-44: 29, emphasis in original).

Here we have the suggestion of multiple learner voices related to age and school standards in addition to pupil abilities. The objectified learner voice is also essentialised here in the sense that the "syllabus compiler" is not the teacher, so that "knowledge of the child" cannot refer to the knowledge of a particular child, but refers

rather to knowledge of "the child" in general, that is, the child of a particular age, standard or ability. In other words, there is an assumption that "the child" in general, can be defined and described. In other words, the description of learners (re)produce ideal acquirers by establishing norms for learner behaviour. In the next chapter I shall show that the reports make a fundamental distinction between "the black child" and "the white child".

4.4 Summary

In conclusion, I will attempt to summarise the voice typology discussed in this chapter diagrammatically. At this point the scheme is meant to offer the reader some orientation to the empirical texts under discussion. In Chapters 5 and 6 I shall consider more closely the hierarchical positioning within categories of learners and teachers and the distribution of message across these voices. These chapters will relate voice and message to the (re)production of theories of instruction which construct models of transmitters and acquirers. Subvoices are thus excluded from this scheme.

Voices and positioning strategies

Voices	**Positioning Strategies**
Dominant voices:	
Researcher	Authorial voice
Academic	Affiliation by authorial voice
Bureaucratic	Displaced authorial voice
Subordinate voices:	
Curriculum developers	Identification with bureaucratic (reader) voice
Teacher	Objectification
Learner	Objectification

Table 4.1

Distributing strategies with respect to curriculum innovation

Distributing strategies with respect to organisation of innovation	Range of message	
	Expanded	**Limited**
Generalising	Researchers	Curriculum developers
Localising	Bureaucrats; Academics	Teachers

Table 4.2
* Learner voice is silent

Distributing strategies with respect to mathematical knowledge

Distributing strategies with respect to mathematical knowledge	Range of message	
	Expanded	**Limited**
Generalising	Researchers; Academics	Curriculum developers
Localising	Bureaucrats learners	Teachers; learners

Table 4.3

In Table 4.2 the bureaucratic voice is dominant in relation to the academic voice with respect to curriculum innovation practices and in Table 4.3, the academic voice is dominant in relation to the bureaucratic voice with respect to mathematical knowledge.

Voices and distribution of message

Voices:	Message distributed to voices:
Researcher	Generalised and localised knowledge of innovation programmes as well as generalised mathematical knowledge.
Academic[7]	Localised knowledge of educational practices and generalised mathematical knowledge.
Bureaucratic	Localised knowledge of educational practices and limited mathematical knowledge.
Teacher	Knowledge of local classroom contexts and limited mathematical knowledge.
Learner	Limited mathematical knowledge, the range of message varies across subvoices.

Table 4.4

4.5 Conclusion

This chapter has been limited to the mapping of positioning and distributing textual strategies onto voices in the text. While it has not produced an analysis of school mathematics as constituted in the reports, it does enable me to position the reports within the field of curriculum production and reproduction. The dominance of the bureaucratic voice, as a displaced authorial voice, and the objectification of teacher and learner voices, positions the reports within the official recontextualising field. Recommendations are clearly directed at effecting change within official pedagogic discourse. The objectification of teacher and learner voices produces a discourse centrally concerned with what should be taught and how; with what teachers should know about their learners and the contents to be taught; with how learners should be organised in the classroom and what knowledge should be distributed to them. The authorial researcher voice affiliates itself with "officialdom" so that there is the suggestion of official approval of the statements in the reports. However, the authorial voice also positions itself, the researcher voice, as the expert with regard to pedagogic knowledge. In this sense it may be argued that the bureaucratic voice is produced as dependent on the researcher voice with respect to the initiation of any

[7] These include mathematicians and mathematics educators

innovation programme. This means that officials might identify a problem area related to curriculum knowledge, but the researchers must tell them how to address it. In this way, the authorial voice marks out a space for the researcher voice to be recruited into the official recontextualising field. More generally, positioning and distributing strategies mark out a space for the reports, through the authorial researcher voice, to influence official pedagogic discourse.

Chapter 5

Theories of instruction: models of acquirers

5.1 Introduction

Acquirers in the reports are textual subjects which are inscribed in pedagogic discourse. This means that acquirers are described in various ways, and positioning and distributing textual strategies are used to constitute them as pedagogic subjects inscribed within theories of instruction. In this chapter I shall consider positioning and distributing textual strategies which constitute a hierarchy of acquirer sub-voices and distribute message across these voices. These will be related to the constitution of theories of instruction which regulate pedagogic communication and (re)produce social relations. The chapter will thus map out how acquirers are differentially positioned with respect to each other, with respect to transmitters and with respect to the distribution of knowledge and moral order.

In this chapter I shall argue that the fundamental distributing principle that constitutes pedagogic discourse in the reports is a racist principle. This principle is used to constitute different theories of instruction for black and white acquirers.[1] While I argue that the fundamental distinction between acquirers is based on a racist principle, in the reports, "race" is displaced by "culture" as the stable referent for differentiating between black and white acquirers. "Culture" is used to describe black and white acquirers as acquirers with different (pre)dispositions to learning. I shall start my analysis by showing how these "predispositions" are used to position black acquirers as subordinate to white acquirers.

[1] Black acquirers are "marked" and white acquirers are "unmarked". That is, the first five reports discuss pupils without reference to colour, while the last two discuss *black* pupils as "other" to white pupils. Here the depiction of white pupils is the same as the "unmarked" pupils depicted in the earlier reports.

I shall then show how "IQ" and "culture" are used as resources to constitute theories of instruction for black and white textual acquirers which have different outcomes relating on one hand to stratification based on work, and on the other to forms of social solidarity. I shall argue that "IQ" and "culture" as used in the reports are structurally similar to "race" in that they are used as resources to (re)produce relations of dominance and subordinace between whites and blacks.

5.2 Culture as an aim of formative education

The aims of "formative education" elaborated in the first Report (0-13) provide the basis for all the later discussions on mathematics instruction and descriptions of model black and white acquirers of mathematics. By formative education they mean the education pupils need to become mature adults. It is noticeable that ideal acquirers are all understood as male acquirers. In this first report, the aims of formative education describe what might be considered the acquirer, in general, for mathematics instruction. Black and white acquirers may be considered as specific cases of this general ideal acquirer. I will thus discuss the descriptions of the acquirer in general, before looking at the descriptions of black and white acquirers.

5.2.1 moral education

From the descriptions of the aims of formative education and initial descriptions of acquirers, it is apparent that learners are viewed as products of particular cultural communities and the value of education is said to lie in how well the learner is taught to act as a responsible adult in his/her community:

> School education is directed towards rendering such assistance to children as they need, in respect of their maturation and eventual entry to adult life. (Maturation here implies the whole of insight, skills and dispositions, at the foundation of which lies a particular order of values as cherished by a particular cultural community.) This assistance is necessary since children are inevitably dependent on the educational assistance of adults, that is, since particular demands are made upon adults, which, of necessity, children are unable to meet (Report 0-13: 6).

Here learners are immediately subordinated in the text through such references as "children". They are described as products of a particular cultural community and as

maturing adults of those communities. *Maturation* is defined in terms of the *values* and practices of the adults within a particular community. These values and practices determine the nature of maturity the child is to aspire to and for which he/she will be moulded through educational assistance from adults. Through maturation, communities are seen to influence the development of *insight*, *skills* and *dispositions* of learners. In other words, they influence intellectual, manual and affective aspects of children's development into adulthood. The cultural community serves here as the resource for the moral education of the child.

5.2.2 career choice

The child, as a maturing adult, is described as an incomplete, dependent being who needs to be nurtured and guided to adulthood. The pedagogic aim suggests a strong social consciousness; an awareness of what children need "in respect of their maturation and eventual entry into adult life". The pedagogue thus needs some insights into the cultural communities of children. They need to know the practices and "order of values" of the communities from which learners come in order to meet the aims of formative education. Besides differences in practices and values, the report also suggests that career choices and meanings attached to mathematics might be different across communities:

> The demand to make a responsible and accountable vocational choice is one of the first and most important demands made on the maturising school-leaver. That in this respect the child is dependent on the educational assistance and support of his parents and teachers, is obvious (Report 0-13: 17).

Vocational choice here is not a matter of personal preference; it has to be a *responsible* and *accountable* choice. Presumably, parents and teachers can render assistance in this respect since they know more about what a *responsible* and *accountable* vocational choice would be for a child of a particular cultural community. The cultural community thus also serves as a resource for making career choices.

5.2.3 Significance attached to mathematics

With respect to the aims of mathematics instruction the report states:

> To give meaning to Mathematics as a cultural system implies that the learning child discovers a particular appreciation for the Mathematics contents which the teacher places within his range of life. When there is talk that the child appreciatively assumes a position towards the presented contents, it is implied that he experiences it (mentally and affectively) as truth and/or as valuable to him, so that eventually he reveals a particular disposition towards it. This encompassing aim at the same time applies as criterion of the validity of particular aims, and in this sense that the accountability of such aims lies inter alia in the fact that they have to conform to the actual significance which Mathematics has in the life of adults of a particular community. (Report 0-13: 7, emphasis in original).

To attach meaning to mathematics thus means to develop a certain disposition towards it; a disposition which is derived from practices within the cultural community. That is, the learner can only experience mathematics as "truth" and "valuable" to him/her if this experience is common to the experience of adults in his/her community. Furthermore, the meaning which adults attach to mathematics is "inevitably borne by their philosophy of life" (ibid: 7). There is the suggestion here that what mathematics gets taught and learnt, and how, is determined by its "meaningfulness" in the life of the adults of a particular community, that is, "on the strength of the various meanings of Mathematics which are actualised by adults in their association with reality" (Report 0-13: 7). In other words, the cultural community also serves as a resource for what contents are to be learnt.

The report thus argues that accountable aims of education must acknowledge different meanings which different communities might attach to mathematics. With regard to the *significance of mathematics*, Report (0-13) elaborates five aspects:

> 2.2.1 Mathematical activities as a matter of handling the quantitative and formal aspects of everyday situations (p10);
> 2.2.2 Mathematical activity as a method of research (p11);
> 2.2.3 The meaning of mathematics as a source of wonder (p12);
> 2.2.4 The meaning of Mathematics as a medium of communication (p12);
> 2.2.5 The significance of Mathematics for labour (p13)

It is asserted that these aspects differ for different communities depending on their material conditions, their "perspective on reality", their relationship with other

communities and their vocational orientations. On this basis it is argued that different communities have different dispositions to mathematics. Communities and their cultural practices are thus differentiated in the reports with respect to "order of values", "perspectives on reality", "dispositions to mathematics" and "vocational orientations". Learners, in turn, are differentiated by virtue of being described as products of particular cultural communities.

5.2.4 Summary

The description of learners here suggests that differences between learners may be read as differences between communities. Within the classroom context, the basic premise seems to be that, one has different cultural communities of children who share the cultural aspirations of their communities and the educational aim is to be directed towards meeting the needs of their particular communities. The argument suggests that the community and its cultural practices must serve as the principle resource for the learner to recognise him/herself within mathematics. In other words, *mathematics must (re)produce the practices and identities which learners derive from their communities.*

Acquirers in general are thus constituted primarily as social subjects that is, subjects whose identities are (re)produced by the cultural communities from which they come. For this reason, black and white acquirers are distinguished first and foremost on the basis of the cultural practices of the communities from which they come. What work the adults of their communities do, what perspective on reality they have, how adults think and behave in relation to adults of other communities and what significance mathematics holds for adults of particular communities, are to be used to develop rules for the selection of contents and for the (re)production of identities for these acquirers. Adults of their respective communities are to be used as models for what acquirers are to become. I shall now discuss descriptions of black and white acquirers inscribed within different theories of instruction. In particular, I will consider what knowledge is distributed to them and how they are positioned in relation to each other.

5.3 The positioning of two model acquirers: "black" and "white"

Reports (0-75; 0-96) explicitly mark out black children as "other" to European children on the basis of differences in "cultural practices" and "world views". They attempt explicitly to show that black acquirers have different dispositions to learning and to mathematics in particular, compared to European or white acquirers. I will consider here three aspects of these dispositions related to individuality, abstract thinking and language, which are used to constitute different theories of instruction for black and white learners.

5.3.1 Individuality

The black acquirer is described as one who has not learnt to think or act as an individual:

> The educational aim of the traditional Black "kraal" is first and foremost to rear the child to become a member of their closed community. Individual thought and actions are tolerated only in so far as these express the group's norms and behaviours (Report 0-75: 7).

> [T]he traditional culture of the Black person offers much less chance of personal interpretation of an adaptation to a situation and the expression of an independent opinion than is the case in a Western society (Report 0-75: 7).

> The unquestioning, almost slavish, obedience expected from the Black child dampens his initiative, originality and creativeness to a great extent. Children are expected to be humble and respectful towards their elders and to conform to the practices and customs of the tribe (Report 0-75: 7).

The black child is presented as lacking the resources from within his/her community to develop an individual and independent attitude to life, and therefore to learning. The black acquirer is constituted through the pathologising of his/her community. The disposition of the black acquirer is desribed as lacking in initiative, creativity, originality and independent thought. This is ascribed to patterns of rearing in the black community, yet these patterns also describe a child who is left to his/her own devices from a very early age and who, one may argue, is forced to grow up quite independently:

> Once the Black baby or child has been weaned, the Black mother does not give the child much of her time. The child is usually left in the care of his brothers and sisters and his peer group. School

going children can mostly expect no help from their parents who usually have no education and are often illiterate (Report 0-75: 7).

However, this is interpreted as an indicator of "insufficient intellectual stimulation" and so again the black acquirer is constitued as "lacking". The black child who is forced to grow up independently does not develop into an independent person, rather, it is argued that he/she does not receive the intellectual stimulation to allow for such development.

In contrast, the community of the white acquirer is described as a community which nurtures the development of the child and celebrates the individuality of the child so that he/she emerges as an independent person:

From his earliest years every child is closely watched by his parents to see if he has not possibly been blessed with special talents and no trouble is spared to ensure that the child is afforded the best opportunity of developing to the full (Report 0-96: 27).

[T]he individuality of the person, especially when it comes to personal responsibility, initiative, original thinking and creative work, is very highly valued in modern Western society (Report 0-96: 28).

This community encourages its children to use their initiative, to be original and creative and to develop a disposition towards independent thought. This leads to the development of other dispositions which black acquirers (again) are said to lack, for example, "natural inquisitiveness", "importance of individual achievement" and "to seek intellectual stimulation" (Report 0-96: 28). We have then a stark contrast between dispositions with respect to individuality, for black and white acquirers.

5.3.2 Abstract thinking

The black pupil is positioned as one who tends to think only concretely and has not developed the disposition to think abstractly:

The Black man considers himself as being part of the earth and he finds it difficult to withdraw himself from it in order to look at it objectively. In order to think objectively and abstractly a person must be able to distantiate himself from his surroundings and view these surroundings as from without (Report 0-75: 15)

> Fundamental research regarding Blacks which was consulted showed that they live closer to nature and are more part of their environment than the European. For this reason the Black people have difficulty in "removing" themselves from their surroundings in order to view a situation abstractly (Report 0-75: 72)

This is the reason given why black people apparently cannot "perceive diagrams three dimensionally" (ibid: 14). It seems that children of western societies do not have the same difficulties, that is, they *have* the disposition to think abstractly since they do not live "close to nature" [sic]. Other reasons given for this difference in dispositions is the difference in perceptions of time; the western child thinks in objectivised time and accepts the "temporality of man", while the black child perceives time in terms of significant events, not as objectified time, and believes in the "life" of his/her ancestors and therefor does not accept the "temporality of man". Again, with respect to the disposition to think abstractly, the black learner is pathologised with respect to the white learner.

5.3.3 Language and learning

There is the argument in the reports that the development of language is crucial to intellectual development, and the black acquirer is pathologised with respect to his/her language:

> - mother tongue languages do not have the necessary mathematical, scientific and technical vocabulary for use as a medium of instruction right through school;
> - languages do not allow communication with Europeans or other Africans;
> - languages are insignificant in commerce and industry in RSA;
>
> (Report 0-75: 78)

In addition, the descriptions of the cultural practices of the black community suggest that the black acquirer is also at a disadvantage with respect to the development of language:

> The development of language in a child begins from the day he [sic] first opens his eyes and it is through the gradual mastery of his mother's communication with him that he is able to attach meaning to his surroundings. As the child grows older and builds up a world of meaning for himself, he is able to dissociate himself from his initial sensory experience of his surroundings to experience them on a more gnostic level. (Report 0-75: 40)

Here we have a description of a "normal" child whose cognitive development begins through communication with his/her mother and who then learns to think independently and to "build a world of meaning for himself" (sic). That is, "he" is learning to think independently. This is in contrast to the description of the way the black child is reared, where the mother "does not give the child much of her time" (ibid: 7) and "the father of the child traditionally takes almost no notice of the child at all" (ibid: 8). In other words, the black learner is (re)produced as one who does not have a prolonged bonding period with a mother or father and thus does not have the resources to attach meaning to his/her surroundings that the normal (and white) child has. The black acquirer is not encouraged to think or act independently and so does not grow up to build a world of meaning for him/herself. Meaning for the black learner is derived from a group or communal experience rather than an individual experience. Here the black acquirer is also pathologised with respect to the "normal" acquirer, while the description of the white acquirer is much closer to that of the "normal acquirer". For example, "normal" learning is described as follows:

> Learning begins with a feeling of curiosity or astonishment about a specific object, matter or problem situation. This curiosity awakens an innate desire and tension to understand and gain insight into the new situation. (Report 0-13: 33)

In other words, a "normal" child is naturally curious and has an innate desire to understand a new situation. So too, the white acquirer, who "is brought up in the belief that he can and must exercise control over his environment" (Report 0-96: 28) and thus "opens himself up to explore everything" (ibid: 29). In contrast, it is argued that the black acquirer lives a life of "unvarying day to day routine in which there is not the slightest need even to read" (Report 0-75: 6). The black acquirer is thus also regarded as a learner with a disposition that lacks curiosity.

5.3.4 Summary

It may be argued that cultural communities are described here as "monoglossic", that is, as "speaking with a single language" (Dowling, 1994: 1). Subjects of these communities, that is, acquirers thus "speak with a single voice". Acquirers are

essentialised and homogenised; curiosity, independent thought, initiative, creativity and so on, are qualities which *all* black children lack and which *all* white children have. On the basis of essential qualities derived from their "cultural communities", the reports (re)produce two textual acquirers with distinct qualities that predispose them to learning in certain ways. The *black acquirer* is constituted as a pathologised learner in a modern western society. He/she lacks the disposition to think creatively, independently, originally and abstractly and lacks an innate disposition to be curious, to explore his/her environment and to act independently. Instead, he/she is attributed with a disposition that favours obedience, conformity, memorisation and communal action and one who is most comfortable with the "concrete" aspects of his/her environment. Descriptions of "lack" position the black acquirer as subordinate to the white acquirer with respect to learning.

In contrast to the "lack" of the black acquirer, the *white acquirer* is constituted as a learner who can cope with the demands of a modern western technological society. He/she has the innate disposition to think creatively, to act independently, to be inquisitive, to explore his/her environment, to think abstractly in the world and to strive for individual success. Also, unlike the pathologised black community, the white community shares the values of western society:

> Western society focuses on production and profit. The criterion for success is high productivity and profit. There is exceptional appreciation for personal initiative and creativity, while lately promotion, success and profit at the expense of someone else are everyday occurrences. From an early age parents of the White child instil him [sic] the importance of achievement, personal initiative and rivalry in family context (Report 0-96: 50).

The white acquirer is thus positioned as dominant with respect to learning abilities demanded of acquirers in a "modern technological society". Below is a summary of the criteria and distinctions the reports make between "Black culture" and "Western culture":

Summary of distinctions between "Black culture" and "Western culture"

Criteria	Black people/Black culture	European people/Western culture
Material conditions and economy	- predominantly rural; - ethnic and traditional; - have made little trade contact with other people;	- only urban; - westernised; - developed trade and economic activity with many people; - criteria for success is high productivity and profit;
Religious beliefs	- witchcraft and belief in ancestory in relion;	- repentence, self-sacrificae and faith in relious beliefs; - western culture based on Christianity;
Cultural practices	- exist in unvarying day-to-day routine; - think and act communally; - no effort to develop the child's potential as an individual; - conformity, conservatism and homogeneity are the order of the day; - culture has no written language; - no education and illiterate;	- adapt, to cope with fast changing everyday situations; - promotion, success and profit at the expense of others are common occurrences; - encourage individual thought and actions; - respect for the dignity of the child is very high; - all history recorded in writing; - highly educated and literate;
Parenting	- do not foster relations of love, trust and understanding with children; - do not provide intellectual stimulation for children; - primary objective of upbringing is to introduce the child to habits and customs of a static pattern of life;	- foster relations of love, trust and understanding with children; - nurture intellectual growth of children; - encourages child to believe that he must excercise control over the environment and therefore to open himself up to explore everything;
Perceptions of time	- time is a composition of events; - does not attach much value to clock time or punctuality; - does not comprehend the temporality of man;	- time is abstract and standardised; - time is objectivised and accounts for all actions; - time is part of the Westerners' life task as an order from above;
Perceptions of space and abstract thinking	- cannot distantiate himself from his surroundings in order to look at it objectively and think about it abstractly;	- can view the world abstractly and objectively, that is, can perceive three dimensional pictures;
Education and math. ability	- have no system of formal schooling; - the advancement of group orientation and the preservation of ancestral spirits are the major educational objectives; - have mathematical ability in so far as the construction of houses, suspension bridges, carving and decoration of sculptures and domestic objects and recognition of number patterns in games; - have unsophistaicated systems of computation and counting limited to small numbers;	- have a long history of formal schooling; - believes that acquiring knowledge leads to control; - instils importance of achievement, personal initiative and rivalry in family and school context; - have mathematical ability and proficiency to cope with the modern technologies of society; - have sophisticated systems of counting and computation involving very large numbers;
Language	- mother tongue languages do not have the necessary mathematical, scientific and technical vocabulary for use as a medium of instruction right through school; - languages do not allow communication with Europeans or other Africans; - langugaes are insignificant in commerce and industry in RSA;	- mother tongue languages have developed the necessary mathematical and technical vocabulary for use as a medium of instruction right through school; - languages accessible as communication medium with Europeans and Africans; - languages are used in commerce and industry in relevant countries;

Table 5.1

I shall now consider in more detail what knowledge is distributed to black and white acquirers, what "theory of instruction" is constituted for each and what the outcomes of these theories of instruction might be.

5.4 Distribution of practices to the black acquirer

5.4.1 Practical and functional mathematics

On the basis of the model of the black acquirer described in the above section, Report (0-75) makes the following recommendations with regard to mathematics instruction for black learners:

> Besides the present Mathematics syllabuses a new Mathematics syllabus which is practical and functional should be provided for Black children (Report 0-75: 73)

> [T]here must be differentiation between Black pupils whose experience of life is largely restricted to the traditional cultural world of Blacks, and pupils who have acquired a larger degree of acculturation. Differentiation should take place not only in respect of learning content, but also in respect of teaching method. Especially with the more traditional oriented Black pupils the learning content should be of a concrete nature whereas the teaching method should concentrate on self-activity and personal involvement in practical situations, especially as regards the teaching of mathematical concepts. Transfer from one group to another should be possible at any time during the year depending on the individual pupil's progress (Report 0-75: 76)[2]

Here only knowledge that is *practical, functional and concrete* is distributed to the black acquirer. This is what "they", black acquirers, are "predisposed" to learn. There is also a consciousness that black learners should not be taught the same mathematical contents as white learners. This is motivated particularly on the basis of the report's "findings" with regard to "the strategy adopted by countries of the Third World, the developing countries of Africa and Asia in developing the mathematical potential of their peoples [sic]" (Report 0-75: 63):

> The "New Maths" if anything, only aggravated the position because it "deals with topics that are abstract, axiomatic and rigorous, and, on the whole, of very little use to most children" (ibid:63, quotes in original).

[2] The "groups' refer to rural blacks as one group and urban blacks as the other group. The latter is considered to be the more "acculturated" with respect to western society.

In other words, abstract knowledge is not to be distributed to black acquirers, neither is knowledge that would demand rigour and systematising. Only mathematical knowledge that relates to their environment and community practices is to be distributed to them. "Abstract" mathematical knowledge has "no use" in the life of the black acquirer since he/she is constituted as lacking in the predisposition to learn abstract knowledge. The only use value or meaning of mathematics for the black acquirer seems to be its "practical" and "functional" value. In other words, a career trajectory, for the lowest levels in the labour market, manual labour, is marked out for the black acquirer. The distinction that is made between "urban" and "rural" black acquirers however, suggests that not all black acquirers are headed for this stratum in the labour market:

> [U]rban Black pupils have a greater cultural advantage than their rural counterparts and can therefore be expected to be cognitively more mature and able to cope with more advanced mathematical concepts. These pupils cannot therefore be held back by over-simplified Mathematics curricula designed for their rural brothers [sic] (Report 0-75: 50).

> Especially now that Black workers are beginning to fill more and more responsible and technically demanding posts, the problem has arisen that many of the Blacks appointed to the higher posts, because of their academic qualifications, do not seem to have sufficient mathematical insight and understanding to be able to cope with problems arising in their work situations. [] Indications are that the above-mentioned problem is one that is found at school level among all population groups, but to a greater degree among Black people (Report 0-75: 2).

> It appears that in the job situation, Black employees' reliance on memorization makes it difficult for them to perform tasks that require mathematical understanding, logical argument and the solving of problems. The question arises whether this problem does not stem to a greater or lesser extent from the didactic situation in Black schools (Report 0-96: 2).

The statements above clearly voice a need for an increasingly technologically-skilled workforce. As the mainstay of such a workforce, black acquirers must acquire the knowledge, skills and competencies to function in the work place. While there seems to be an indexing of a need for some specialising practices for blacks in urban contexts, the specialised practices relates to problem solving in the work place rather than specialised activities. In other words, "practical and functional" mathematics courses for black acquirers must provide access to "mathematical insight, logical argument and problem solving" in so far as they relate to work problems. In this way, mathematics will provide opportunities for some mobility between black workers in

that they would be "skilled" to perform a wider variety of tasks. The exclusion of abstract and generalised mathematics from courses for black learners suggests that this mobility is limited to the lowest levels of the labour market. That is, from manual to semi-skilled labour, where mathematical insights allow them to become more effective workers.

Black acquirers then are categorised into two homogeneous groups: "rural blacks" and "urban blacks". Transfer between "rural" and "urban" means the acquirer will have access to higher academic qualifications and to skilled or semi-skilled labour. In both cases practical and functional mathematical knowledge is distributed to them, rather than generalised or abstract mathematics. Whether urban or rural, black workers are still located at the most constraining levels of the general division of labour. While there is the suggestion of mobility between blacks, mobility is produced largely by not allowing blacks to specialise. In other words, if they are located at the most lowest levels of the (general) division of labour, they can be used in a multitude of (local) divisions of labour within specialised activities. From another perspective, it may also be argued that the need for some specialising of blacks in urban contexts relates to a need for blacks to take up occupations which might generally have been preserved for whites, but which have become dangerous occupations for whites in black group areas. For example, policemen, teachers, municipal officers and so forth. So, while the knowledge distributed to black acquirers is restricted it must also provide some access to these types of occupations.

5.4.2 Group identities

It is noticeable that black acquirers are differentiated only with respect to "urban" and "rural". Individual black acquirers are not differentiated; there is no reference to black pupils with differential learning abilities. They are constituted with strong group identities, either "rural black" or "urban black". In fact, in one of the above extracts we have a reference to "transfer from one group to another" that is, from rural to urban. The theory of instruction constituted for black acquirers, is aimed at maintaining such group identity. Black acquirers are identified in the reports with

mine workers, so that the theory of instruction draws explicitly on the experience of the mining industry which is seen to operate entirely on "teamwork":

> Work teams are not grouped together at random, but careful attention is given to the choice of individuals in such a team, particularly with regard to the "boss-boy". When the members of such a team work together well under the boss-boy, the zeal, loyalty and responsibility of every member in group context is of the highest order. If such a team is disbanded, however and each member has to carry on with work as an individual, such an individual appears to be uncertain and confused (Report 0-96:68)

In other words, black acquirers must see themselves as part of a "team" working towards the same goals. The identification with mineworkers clearly positions black acquirers as subordinate voices with respect to the division of labour in society. It is interesting that in the mining context, group "loyalty" is looked upon as something positive, whereas in descriptions of the black acquirer earlier, this was viewed negatively as an indicator of a lack: a "lack of initiative and independent thinking". In the spirit of "teamwork" and "in line with the indigenous [sic] educational practice of African societies" (Report 0-96: 78), there are explicit attempts at pre-empting the (re)production of individual identities for black learners in recommendations made for the most suitable pedagogic contexts for black acquirers. These recommendations are:

> a. The arrangement of the pupils in cohesive mixed-ability groups within each class.
> b. Pupil co-operation within each group on all learning tasks including homework.
> c. Evaluation based solely on group work to avoid competitiveness between individual pupils.
>
> (Report 0-96: 78)

The theory of instruction must thus ensure that a group identity for blacks is (re)produced. There is no imperative to provide opportunities for acquirers to strive towards individual success. The pedagogic consciousness of the learner must be geared towards group performance. The "group" must acquire the skills and competencies necessary for their functioning in the labour market. These skills and competencies are common to all. In other words, black acquirers must become an effecient work force, either as manual labourers or as semi-skilled workers. Their coherence is dependent on their group identity and recognition of shared

competencies. Black acquirers are constituted as homogeneous groups of either "urban" or "rural" *blacks,* that is, "blacks" are all the same.

5.4.3 Shared competencies and mechanical solidarity[3]

We have here, for black acquirers, the (re)production of what Bernstein (1990) refers to as "similar to" relations. Drawing on Durkheim (1984), he characterises such relations as relations which are regulated by *mechanical solidarity.*[4] Groups who exhibit this form of solidarity do not act in the personal interests of individual members, but pursue only collective ends. This form of solidarity, according to Durkheim (1984), is consistent with a low division of labour. While he refers to mechanical solidarity as "high solidarity", Durkheim asserts that the cohesion of this solidarity is fairly weak. By this he means that new individuals may join, or others may leave such groups without having too much effect on the relationships within the group. It was argued above that "similar to" relations (re)produced for black acquirers are derived from relations (re)produced for black workers. In other words, the regulation of mechanical solidarity may be related to the form of mobility produced for black workers, that is, at the most constraining levels of the (general) division of labour, activities are not specialised, so that any black person can do the work that is required and therefore, the stability of the group and its collective functioning is hardly disrupted by mobility between workers.

To summarise, the theory of instruction constitued for black acquirers limits the (re)production of individual identities and strengthens group identities. Specialised identities for black acquirers rests upon a particular social order, that is, upon the regulation of relations between groups, for example, between blacks and whites or between rural blacks and urban blacks. The theory of instruction has as an outcome, shared competencies for acquirers. It (re)produces a model of the pedagogic context

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[3] Thanks to Zain Davis who suggested, following Dowling and Brown (1996), that Bernstein's use of mechanical and organic solidarity may be useful concepts to describe pedagogic relations in this study.
[4] While Durkheim's (1984) work referred to the organisation of whole societies, Bernstein (1990) uses Durkheim's concepts to describe different forms of the division of labour which co-exist in societies. (See also Dowling, 1995: 65).

which is to be regulated by mechanical solidarity and constitutes acquirers that will inhabit the lowest levels in the division of labour in society.

5.5 Distribution of practices to the white acquirer

The white acquirer is the unmarked acquirer, that is, the acquirer who is not referenced by colour and does not fit the description of the black acquirer. In other words, the white acquirer is identified as the "other" of the black acquirer. We recognise the white acquirer by knowing who the black acquirer is. In particular, the white acquirer is the learner who is described as an individual learner with personal needs and abilities. The community which influences the identity of this acquirer, celebrates the achievement of individual identities.

5.5.1 Mutual differences

The model white acquirer is described as an acquirer who has an innate disposition to be curious and to explore his environment and is predisposed to thinking creatively, abstractly and independently. This learner is constitued by a predisposition to act as an individual and to realise his individual "potential". White communities encourage their children to "develop into what they aught [sic] to develop into on the strength of their positive human potentialities and this implies optimal development of their particular potentialities" (Report 0-13: 17). For example, the report marks out acquirers for whom "mathematical activities as such could be significant as a matter of self-actualisation" (Report 0-13: 18) and suggests that education should "provide such pupils the opportunity towards creative and original mathematical activity, and to orientate them in respect of its nature" (ibid: 18). For these acquirers, *self-actualisation* is achieved through mathematical activity and they are encouraged to pursue further mathematical activities through *creative* and *original* work. White acquirers are thus viewed as those who can individuate themselves through mathematical activity. The independence of the acquirer relates particularly to choices that he can make with respect to future employment:

> [A] person's potential for acquiring perspective in respect of technological aspects of the contemporary reality which surrounds him, is related to a particular degree with his mathematical knowledge and competency (Report 0-13: 16)

> [T]he pupil, if he considers a vocational field for which mathematical ability is a prerequisite, inevitably has to obtain perspective, that is he has to be capable of self-evaluation with regard to his mathematical proficiencies. [..] The child must make a realistic vocational choice which is related to his specific mathematical aptitude and ability (ibid: 17).

These acquirers are thus constituted as individual learning subjects whose identities are shaped by their personal experiences and internalisation of mathematics. The theory of instruction is directed at meeting the needs of individuals, thus maintaining what they call "mutual differences" among acquirers:

> [D]ifferentiation is meaningful in respect of the actualisation of aims of Mathematics instruction, especially on the strength of the mutual differences among children in respect of mathematical aptitude, learning readiness and future directedness. In view of such mutual differences, differentiation in respect of syllabus contents and didactical shaping of the instruction may also contribute towards increased actualisation of aims of Mathematics instruction. (Report 0-13: 37)

Here we have a motivation for a *differentiated system* of mathematics instruction in order to meet the needs of individual acquirers. In other words, the theory of instruction constitutes acquirers who may be differentiated with respect to individual mathematical aptitudes and learning readiness and on this basis differentially distributes mathematical knowledge to them. The distribution of knowledge however is made much more complex with the elaboration of what constitutes "mutual differences" between acquirers. The differences are not only "mathematical aptitude, learning readiness and future directedness". It is also all the personal "attributes" listed below:

intelligence (IQ);	ability;	aptitude;	ambition;
learning readiness	age;	self realisation;	motivation;
perseverance;	dedication;	occupational ideals;	interest;
ability to assimilate and master contents;	domestic background;	cultural environment;	learning tempo;
significance attached to mathematics;	accepting responsibility;	maintaining independence;	learning directedness;
class standards;	foreknowledge;	potentialities	proficiency

These are all personal attributes on the basis of which individual white acquirers are differentiated in the reports. These attributes are grouped in certain ways and used as

resources in a theory of instruction that constitues a hierarchy of acquirer voices to which mathematical knowledge is differentially distributed.

5.5.2 IQ and student voices

Report (0-44) marks out two categories of acquirers based on individual differences, *restricted normal pupils* and *talented pupils*. These two categories may be regarded as representing two extreme points of a scale for measuring acquirers. That is, they mark out two particular subject positions for white acquirers:

> Restricted normal (dull normal):
> In the school situation the restricted normal pupil can usually be identified by the fact that even at primary school level he could only rarely, or, never, succeed in equalling the average scholastic achievement of his class group. His poor scholastic achievement may normally be due in part to defective intellectual ability. A pupil with an IQ between 80 and 89 is usually classified as restricted normal. On the other hand, poor scholastic achievement may also correspond with personal shortcomings such as ineffective perseverance, ambition or dedication. During the primary phase provision is already made for such pupils with adaptation and special education. Since inevitably these pupils will find no satisfaction of self-realisation in the general subject contents, they have to be introduced [..] to the practical occupationally directed subjects. A practically oriented course in mathematics should be implemented for these pupils from Standard 6 (Report 0-44:37).

> Talented pupils:
> [P]upils with an IQ of 120+ are regarded as talented. However, other criteria such as scholastic achievement, learning readiness, perseverance and dedication are also taken into account. In the school situation the talented pupil can be identified by the fact that he is able to reach a considerably higher level of scholastic achievement than the average for his age group. This group of pupils normally finds satisfaction of self realisation in the general subject contents and envisage tertiary training (0-44:39).

Each category compares pupils' performances with respect to the average performances of an age or class group. It seems possible therefore, that because these categories are relative, students could shift along this scale from class to class or year to year. For example, a student classified as restricted normal in one class may be less so if moved into a class with a lower class average. Similarly, a 12 year old classified as talented for his/her age group may, at the age of 14, be identified as average for his/her age group. It is clear however from the above extracts, that these categories are fixed on the basis of IQ. A pupil in primary school, for example, with an IQ between 80 and 89, would be classified as restricted normal. There is no suggestion that this might change over time, or that the pupil should be retested when s/he

reaches secondary school. In other words, IQ is constituted as innate; it is quantifiable and it is a resource for the constitution of identity for learners. If you know your IQ, you know who and what you are. IQ serves as a stable referent, in the same way as "culture" does for black acquirers, for the constitution of identities for white acquirers. Despite the references to other criteria in the above extracts, these criteria would not really alter the initial categorisation of pupils as restricted normal or talented. A pupil with an IQ between 80 and 89, who possesses all the positive criteria of the talented pupils like *learning readiness*, *perseverance* and *dedication*, would still not be categorised as talented. IQ in other words, is a fixed quality upon which the distribution of knowledge is based. That is, for an IQ between 80 and 89 you do a practical course in mathematics; for an IQ of 120+ you do a higher grade academic course. An IQ identity is innate, and so it constitutes an individual independent of external influences. At the same time it creates a hierarchy of pupil voices which range from *restricted normal* to *talented.*

So for example, an IQ of 80-89 marks out a particular subject position for pupils, namely, *restricted normal.* This category constitutes a subordinate student voice which is "below average", is considered to have "defective intellectual ability", and has a number of "personal shortcomings such as ineffective perseverance, ambition and dedication". On the other hand, an IQ of 120+ positions pupils as *talented*; this subject position constitutes a dominant student voice which is "above average" and which "normally finds satisfaction of self-realisation in the general subject contents and envisage tertiary training". Talented pupils do *not* have ineffective perseverance, ambition and dedication.

While IQ is used as a principal resource for differentiating white acquirers, in the above descriptions it is combined with other criteria like perseverance, ambition and dedication, to establish the subject positions for *restricted normal* and *talented* pupils. This might suggest that if a learner's IQ identity is not strongly classified (eg. 120+), say it is average, then other criteria become the resources for establishing subject positions. IQ is clearly quantifiable and according to its measure and assumptions, determines things like *intelligence*, *ability*, *aptitude* and *learning tempo*.

Since IQ is constituted as innate, these personal qualities are too. What then determines some of the other criteria listed in Table 1 that are also used for differentiating white acquirers? That is, personal qualities like *learning readiness, interest, accepting responsibility, significance attached to mathematics, motivation, maintaining independence etc.* which are not clearly determined by IQ? It may be argued that these qualities are a measure of some or other performance over time and so we may cluster them as *acquired* characteristics rather innate. As such they must be subject to external influences. For example, *learning readiness* is described elsewhere in Report (0-44) as:

> [E]ssentially a condition which a pupil attains in the course of time as a result of his particular aptitude and under the influence of his specific environment. It is one of the inner (personal) factors responsible for the smooth progress of the learning process. (Report 0-44: 22)

It could be argued that *aptitude* is influenced by IQ and therefore IQ determines learning readiness and so perhaps learning readiness is also innate. But it is argued above that learning readiness is also influenced by the *specific environment* of the acquirer. Since IQ is independent of the environment, it may be argued that *environment* is a second resource that determines criteria for differentiating white acquirers. That is, *learning readiness, perseverance, ambition, dedication, interest, accepting responsibility, significance attached to mathematics, motivation, maintaining independence etc.* are shaped by the values and practices of the pupil's particular environment (community) and so are products of his/her social identity. However, white acquirers here are not described in terms of the practices of their cultural communities. Their social identities are individual rather than communal. They must individuate themselves in the context of their community. Their environment is used as a principal resource to determine *personal* attributes of learners, rather than essential qualities shared by a "group". Their identities in other words, are constituted through an evaluation of the self. That is, they are products of qualities internal to the learner. In contrast to the (re)production of group identities for black acquirers, the constitution of individual identities for white acquirers in itself constitutes his (sic) identity as white. In this sense, the (re)production of individual identities for white acquirers, (re)produces a white identity.

Age is independent of both IQ and cultural environment. It is used as a resource to establish subject positions for learners. For example, the report makes reference to children of a certain age who may or may not *be ready* to learn certain contents. Age essentially positions pupils into *class standards*. IQ, together with other personal attributes determined by cultural environment, positions pupils *within* class standards.

The personal attributes or criteria listed earlier may thus be reorganised into three strands of personal attributes used to differentiate white acquirers within class standards. The three strands are marked out according to whether they are determined by IQ, cultural environment or both:

Resources for differentiating white acquirers

Determined by:	Personal attributes
IQ	intelligence ability aptitude learning tempo
IQ and cultural environment	Learning readiness proficiency potentialities significance attached to mathematics abilities for logical and abstract thought ability to assimilate and master contents self realisation
cultural environment	interest perseverance ambition learning directedness motivation independence responsibility dedication occupational ideals foreknowledge

Table 5.2

White acquirers are thus constituted as individuals with mutual differences, some of these innate, some of these outcomes of their cultural environments. In addition, the combination of innate and acquired abilities to learn constitue white acquirers as acquirers with some measure of control over their own learning. For the white acquirer, IQ is an accident of birth, it cannot be controlled by the acquirer. However,

a certain IQ means that the acquirer has a particular aptitude and ability to do mathematics which he must realise. With an average IQ, an acquirer may draw on other acquired characteristics like dedication, ambition, responsibility and so on, which are the products of the acquirer's cultural environment, to achieve performances associated with high IQ abilities. In other words, the whole person, everything about the self, innate and acquired, serves as a resource to constitute an identity for the white acquirer and to establish his student voice.

5.5.3 Specialised performances

I shall now consider how mathematical knowledge is distributed to potentially, a variety of student voices. Report (0-44) is explicit about offering differentiated syllabuses:

> The Mathematics syllabus need not impose the same demands on all pupils with regard to the mastery of subject matter, the tempo at which the work is done and the level at which it is processed (Report: 0-44:31).

Two basic requirements are specified for differentiating mathematical knowledge. The first is the *formative value* of mathematics and the second is *different fields of study*. The formative value differentiates the streaming of mathematics into *mathematics as a science*, which emphasises the study of abstract concepts and structure in mathematics and *mathematics as a subject*, which emphasises the applied nature of mathematics, presenting the contents "in situations which closely simulate reality and life" (Report: 0-44: 33). In marking out "different fields of study" as a motivation for occupationally directed education for white acquirers, there is some indication of "reality" and "life" for these acquirers. The report suggests different streams of mathematics syllabuses based on this criteria, which may be placed along an intellectual-manual continuum and range from a *natural science course* to a *technical and practical course* of study. Table 5.3 presents a list of the different streams:

List of mathematical courses for white acquirers

Mathematics as a science	Mathematics as a subject
General course[5]	
Natural science course	Commercial course
	Agricultural course
	Art course
	Home economics course
	Course in humanities
	Technical course
	Practical course

Table 5.3

White acquirers are thus constituted as a highly differentiated group of acquirers. Differences between acquirers is celebrated. The theory of instruction constitutes a hierachy of student voices through complex arrangements of innate and acquired personal attributes. Knowledge is distributed to (re)produce a multitude of specialised performances so that white acquirers (re)produce the stratification with respect to work in a complex division of labour. White acquirers may potentially occupy all the strata of the general division of labour: intellectual, skilled, semi-skilled and manual, although "practical work" is reserved only for a small group of white acquirers, namely, those positioned as "restricted normal". As such, white acquirers, compared to black acquirers, are positioned as dominant with respect to mathematical ability and with respect to positions within the general division of labour.

At the centre of pedagogic consciousness for white acquirers is the "self"; white acquirers are to be given opportunities for self-evaluation so as to realise their individual potential and some or other specialised performance. Unlike black acquirers, their group identity does not automatically position them within class standards with respect to the distribution of knowledge. Within the class standard, the white child's IQ is evaluated to determine whether he/she is average, below average or above average. This evaluation, together with the person's dedication, ambition, perseverance, willingness to accept responsibility, significance attached to mathematics and perhaps a few more criteria, will determine which mathematical course he/she is best "suited" for.

[5] These courses are given in the report as that which has been legislated in the National Education Policy Act of 1967 (Article 2(1)).

5.5.4 Organic solidarity

Here the theory of instruction (re)produces "different from" relations which Bernstein (1990), again drawing on Durkheim (1984), associates with *organic solidarity*. Groups who exhibit this form of solidarity celebrate differences and allow scope for individual initiatives and for movements across subject positions; individuals pursue their own interests and are not bound to group identities. We may think here of white acquirers who can move across subject positions by virtue of acquired characteristics, especially when IQ is not strongly classified. According to Durkheim (1984), organic solidarity is consistent with a complex division of labour. Although he refers to this form of solidarity as "low solidarity", he points out that, in contrast to mechanical solidarity, the cohesion within groups regulated by organic solidarity is much stronger:

> Society becomes more effective in moving in concert, at the same time as each of its elements has more movements that are peculiarly its own (Durkheim, 1984:85)

> [W]here society constitutes a system of differentiated parts complementary to one another, new elements cannot be grafted on to the old ones without disturbing their harmony and changing these relationships. Consequently the organism resists intrusions that cannot occur without upsetting its balance (Durkheim, 1984:105)

The theory of instruction constituted for white acquirers has as an outcome, specialised performances for acquirers. It (re)produces a model of the pedagogic context which is to be regulated by organic solidarity and constitutes acquirers that will inhabit a complex division of labour in society. Specialised identities for white acquirers rests upon an evaluation of the self. Group identity is preserved through the (re)production of a multitude of individual identities. This relates particularly to the preservation of the white identity within a complex division of labour in society.

The table below presents a summary of the positioning of, and the distribution of practices to black and white acquirers:

Positioning and distribution of practices to acquirers

Acquirers		
Positioning in terms of:	**White acquirers**	**Black acquirers**
Positioning in terms of:	IQ age personal attributes e.g. learning readiness; perseverence; occupational ideals; learning tempo; foreknowledge etc.	urban - age rural - age
Distribution of mathematical knowledge:	Range of mathematical courses e.g. natural science course, general course; commercial course, technical course etc.	Practical mathematics (non-academic course)
Distribution of careers:	Multiple career trajectories for complex division of labour	Semi-skilled and unskilled labour for simple division of labour
Distribution of social relations:	Organic solidarity	Mechanical solidarity

Table 5.4

5.6 Conclusion

It is clear that a racist distributing principle underpins the constitution of different theories of instruction for black and white acquirers. In relation to white acquirers, black acquirers are positioned as subordinate voices with respect to mathematical ability and with respect to the division of labour in society. Specialised identities for black acquirers rests upon relations between groups, while identities for white acquirers rests upon an evaluation of the self. Furthermore, different theories of instruction (re)produce different models of the pedagogic context; for black acquirers this is regulated by mechanical solidarity and for white acquirers by organic solidarity. Models of the pedagogic context (re)produce forms of solidarity at different levels of the division of labour in society. The theory of instruction for black acquirers constitutes acquirers that inhabit a simple division of labour, while the theory of instruction for white acquirers constitutes acquirers that will occupy positions in a complex division of labour in society.

It may be argued therefore, that the theories of instruction for black and white acquirers (re)produce the positions of white dominance and black subordination in the broader society. This conclusion is significant because the reports are offered as authoritative statements towards the "promotion and innovation of Mathematics instruction in South Africa" and within these statements, racism is masked by the use of "culture" and "IQ" as principal resources for the differentiation of acquirers. The reports in other words, constitute official pedagogic discourse that is apparently non-racist and is supported by agencies within the PRF. It is therefore of interest to explore the extent to which pedagogic discourse (re)produced in the reports pre-figure current curriculum changes. That is, within a non-racial democracy, to what extent do these theories of instruction still exist? This question will be considered in the conclusion. In the next chapter I shall discuss theories of instruction with respect to the (re)production of models of transmitters.

Chapter 6

Theories of instruction: models of transmitters

6.1 Introduction

In Chapter 4 I discussed positioning and distributing strategies related to voice and message in the reports. I argued that teacher voices were objectified voices positioned as subordinate to academic and bureaucratic voices and as dominant with respect to learner voices. In this chapter I want to consider the hierarchising of teacher sub-voices. More particularly, I want to consider teacher sub-voices as models of transmitters constituted through the different theories of instruction for black and white acquirers. The analysis will once again focus on positioning and the distribution of knowledge to teacher voices. I shall argue that the different theories of instruction (re)produce different models of transmitters which again relate to the racist distributing principle that underlies these theories of instruction. Transmitters thus refer here to textual transmitters inscribed in pedagogic discourse.

6.2 Positioning of transmitters in general

Once again, the ideal transmitter is understood as male. Transmitters in general are described as reproducers of pedagogic discourse, that is, they reproduce in the classroom context, what has been defined as official pedagogic discourse. They teach the contents, follow the sequencing and adopt the teaching methodologies that are prescribed in official syllabuses and textbooks. Teachers are constituted as transmitters with limited autonomy with respect to the sequencing and pacing of lessons and the pursuance of aims in mathematics instruction. Secondly, transmitters, in general, are constituted as primary regulators of the pedagogic context. That is, within the classroom context, teachers regulate what and how knowledge is transmitted to learners. They also influence the meaning learners attach to subject contents and perspectives learners adopt with regard to the demands of adult life. Finally, teachers, in general, are also constituted as objects of change, meaning that

teachers can always be retrained to implement new ideas from innovation programmes. It may be argued that the model of transmitters, in general, positions teachers as potential allies of the State and its bureaucracy in the implementation of official pedagogic discourse. They may be retrained, if necessary, to reproduce official pedagogic discourse and to regulate the pedagogic context to ensure the intended outcomes of official pedagogic discourse. It is therefore pertinent to consider the specific models of transmitters constituted by the two theories of instruction discussed in the previous chapter.

6.2.1 Identifying black and white teachers

Report (0-31) surveys "the training of mathematics teachers in the republic of South Africa". It is clear that the survey includes only institutions for the training of *white teachers* and statistics regarding white teachers. Thus, none of the historically black university or college teacher training programmes are reviewed, nor are statistics regarding the shortage of mathematics teachers in black schools considered. In the Western Cape, for example, only the University of Cape Town, Stellenbosch University and Cape Town Teachers' Training College are considered; excluded are at least four teacher training colleges for non-white students as well as the pre-service courses of the University of the Western Cape. This is simply an indication of how much "data" is *not* considered in the report's survey of "the training of mathematics teachers in the republic of South Africa". References to "teachers" in this report thus index only white teachers. "Black teachers" on the other hand are marked out in Report (0-75) as teachers of black acquirers. In both reports knowledge is distributed to teacher voices to constitute a hierarchy of subvoices.

6.3 Positioning and distribution of practices to black teachers

Report (0-75: 77) recommends that:

> Since it is precisely the Black pupil's dependence on rote learning without much understanding which is causing concern in the work situation, research should be undertaken to determine the most suitable teaching methods to aid the Black man to master Mathematics with insight in order that he may be able to apply his mathematical knowledge in practical situations. These teaching

methods should then be stressed at all institutions concerned with the training and in-service training of Black teachers of Mathematics.

There is an assertion firstly, that black teachers will teach black pupils and secondly, that "mastery of mathematics with insight" for black pupils, implies the ability to *apply* mathematical knowledge. The teaching method must therefore take into consideration the applied knowledge that black pupils' need. This has to be read in the context of the proposal for a "practical, functional and environmentally oriented Mathematics curriculum" that ensures "the development of the mathematical potential of all the Black pupils" (Report 0-75: 77). In other words, the black teacher must have the practical and functional mathematical knowledge that he (sic) is to teach to black pupils. Black teachers must be able to design or reference "practical situations" in which black pupils can engage with mathematical concepts. The "practical situations" must resemble work situations that black people find themselves in, so that black pupils may relate to these situations. Black teachers must thus have knowledge of the working community into which black pupils are to be incorporated. This may be related to the communal identities (re)produced for black acquirers. Black teachers must have the appropriate "theory of reading" the black child and this is, to know the community from the which the child comes. There are no references to other forms of mathematical knowledge that black teachers should have.

The "most suitable teaching method" for black pupils is described in Report (0-96) as "a group-oriented educational strategy". A strategy that requires black pupils to be taught in groups and a strategy that (re)produces black pupils with a strong social identity. To achieve this the following recommendations are made with regard to what knowledge black teachers should have:

> Apart from the teacher's task to instruct, group-oriented education requires understanding and knowledge of the placing of pupils into harmonious groups, the handling of these groups as well as individuals in each group, the organisation and co-ordination of group activities as well as the evaluation of the activities of the groups, both inside and outside the classroom. In order to succeed in this, the teacher must have a close relationship with the local community. He [sic] will have to be familiar with the people and their circumstances in order to place the pupils correctly in their various groups, especially because the groups must function outside the classroom and even outside school context. [...] It is therefore obvious that the teacher should have the same cultural background as the children and have the same tribal [sic] or national affiliations (Report 0-96: 79).

In other words, the black teacher, to teach black pupils successfully, must have localised social knowledge; knowledge of local community conditions and practices. Such localised knowledge gives them access to the "practical situations" which are appropriate for black pupils and the "applied knowledge" these pupils will need as adults in their communities. In doing so, they will be able to teach mathematics with insight to black pupils. In addition, it is suggested here that teachers can best acquire such social knowledge if they themselves "have the same cultural background" and "tribal and national affiliations" as their pupils. That is, black teachers must draw on the social knowledge that they themselves have. The identity of the black teacher thus also rests upon his/her social consciousness, that is, upon the conditions that define him/her as black, in particular relations defined between blacks and whites.

The training of black teachers is compared in the reports to the training of "team leaders" in the mining industry:

> Organisers [of teacher training] should be fully acquainted with the experience of the mining industry *inter alia* regarding the organisation, control and motivation of work teams (Report 0-96: 79, emphasis in original)

There is a suggestion here of an equivalence between the organisation of miners into "work teams" and the organisation of black students into "groups" and so it is again localised knowledge, knowledge of local mining conditions, which is distributed to black teachers. There is also the suggestion that "mining conditions" most closely resemble the work conditions of black teachers and also represents the type of "practical situations" which black teachers must draw on to teach mathematics with insight to black pupils.

I have already mentioned the exclusion of references to teacher training institutions for black teachers and thus, besides the above reference to the mining industry, there are no references to other contents of teacher training courses for black teachers. The silence almost suggests that the mathematical contents of teacher training courses are less important than the localised social knowledge that the black teacher gathers from being part of the same community as his students. In other words, the black teacher is

constituted as one who does not need specialised training; all he needs is to be familiar with the local conditions and practices of his pupils and to be familiar with how work teams are organised in the mining industry. Such knowledge will allow him to organise black pupils into "harmonious groups" and provide "practical situations", related to the experiences of black pupils, for engaging with mathematical concepts. The black teacher does not need specialised training to teach homogenous groups of black pupils.

6.4 Positioning and distribution of practices to white teachers

Descriptions of the white teacher has to be read in the context of a theory of instruction that (re)produces specialised competencies for white acquirers. I will discuss descriptions of white teachers with reference to three aspects, namely, qualifications, specialised knowledge and differentiation between primary and secondary teachers.

6.4.1 Qualifications

Report (0-31) reports on the training of white teachers and reviews teacher training courses at historically white universities and teacher training colleges. The report differentiates primary and secondary white teachers suggesting that their needs are different and therefore knowledge is differentially distributed to them. There is however a strong sentiment that both primary and secondary teachers should be encouraged to train at universities or alternatively, that diploma courses at teacher training colleges seek equivalencies with university courses in order to obtain accreditation from universities. The sentiment is based on a belief that university degrees will lend more status to teacher training courses:

> [T]he introduction of any Mathematics courses fulfilling the need of teachers in the schools must necessarily be recognised for degree purposes in order to enhance the teaching profession's status (Report 0-31: 274)

The report argues that a necessary requirement for granting degree status to teacher training courses is that candidates should at least have matric qualifications. As such,

the report makes a special recommendation for "setting the minimum admission requirements for the primary school teacher's diploma[1] to include Mathematics passed at Standard 10 level" (Report 0-31: 270). The motivation given in the report is that:

> [T]his report found no shortage of primary school teachers being experienced in any of the provinces. Standards of selection may therefore be raised without causing a shortage in schools (Report 0-31: 271).

Of course, the survey was based only on white schools and white teachers. It may be argued that the recommendations and critiques of teacher training courses for white teachers in the reports signifies an attempt to (re)produce a highly qualified core of white teachers in both primary and secondary white schools. There is an argument for qualifications to be raised to matric mathematics as entrance requirements for teacher training courses and equivalent degree mathematics courses in the teaching diplomas. There is thus an assumption that higher qualifications will lead to improved teaching. For example, the report makes reference to a preservice course offered for secondary teachers at the University of the Witwatersrand to assert that:

> Not only would the introduction of such Mathematics for Teachers Courses on first- year and second-year university level contribute to the status of the teaching profession, but it would also improve the teaching of Mathematics in the secondary schools (Report 0-31: 275).

The idea is also that granting degree status to courses will make the profession "more attractive" (ibid: 262). There is a particular interest expressed in the report to make the profession "more attractive" for males:

> It is often stated that there can be no objection to women only as far as the primary schools are concerned. This is a fallacy and a dangerous one at that. Just as much as a father is absolutely necessary in the home to ensure the proper upbringing of the children, so are male teachers necessary in the primary and secondary schools. [...] In short, it is not only the fact that there are no male teachers to discipline the boys, but it is especially the fact that the girls have no father-figure to look up to and the ensuing interest in boys who are basically too young for such attention that leads to poor discipline (Report 0-31: 263).

So while there seems to be a strategy to recruit more males through offering degree status to more teacher training courses, males are required especially for the

[1] Students at that time could enter this diploma with only standard six mathematics to their credit. Secondary teacher diplomas always required standard ten mathematics.

"discipline" and "moral education" they are assumed to provide as teachers. Female teachers are constituted as lacking or weak in this regard. Nonetheless, white teachers are constituted as having some moral responsibility in the education of their students. As such, the report makes the point that attracting "high calibre" students into the teaching profession refers "not only to academic excellence but also to qualities of character, potential for leadership and a religious upbringing" (Report 0-31: 276).

6.4.2 Specialised knowledge

In the discussions of teacher training courses, two forms of specialised knowledge, namely, mathematical knowledge and pedagogic/didactical knowledge, is associated with teachers. Mathematical knowledge is discussed mostly with reference to academic mathematics courses, while pedagogic knowledge is discussed with reference to "subject method" or "didactic" courses. In this section I want to consider the nature of and differences between mathematical and pedagogic knowledge described in the reports and their distribution to white teachers.

6.4.2.1 Mathematical knowledge

Recommendations for the training of white student teachers constitutes teachers who are highly competent in mathematics; teachers who display, in their teaching, *insight into mathematics*:

> Possibly one of the greatest shortcomings of Mathematics teachers is that they do not realise what sense and meaning Mathematics can and should have for their pupils and consequently the teaching of Mathematics has degenerated to the mere reproduction of so many tricks. Insight into the aims of the teaching of mathematics is therefore absolutely necessary (Report 0-31: 4).

> It is only when a student gets an insight into the interdependence of the various topics and their place in the whole, that Mathematics can become meaningful to him. A Mathematics teacher with such an insight into Mathematics will surely not present his lessons as series of recipes and techniques which have to be applied to specific types of problems. [...] The idea of Mathematics as a logical system which has been developed by man is of the greatest importance, yet it is seldom if ever implemented in the schools (Report 0-31: 4).

In contrast to the discussion of black acquirers and teachers, here mathematical insight implies the ability to make connections between mathematical topics and the

suggestion is that white teachers need to have generalised knowledge of mathematics in order to make such interconnections between mathematical topics in their teaching. There is an emphasis on the teaching of "structure" in mathematics rather than the teaching of only "algorithms" or techniques for solving specific problems. The assumption is that generalised mathematical knowledge, that is access to the "structure" of mathematics, would mean that white teachers would not have to resort to "recipes" and "tricks" in their teaching. It is suggested that emphasising structure in the teaching of mathematics will "awaken the interest of pupils" (ibid:4) into mathematics, while the teaching of algorithms and other "tricks" is "dull and uninspiring" (ibid:4) for pupils. In other words, white pupils too are to be given access to generalised mathematical knowledge in order to make interconnections between mathematical topics. The descriptions here contrast strongly to the distribution of "practical mathematical knowledge" to both black acquirers and teachers.

White teachers are also constituted as having differential mathematical abilities. For example, the report refers to the training of "prospective teachers of Mathematics of relatively lower academic calibre" (Report 0-31: 276). These are identified as student teachers without matriculation exemption who enrol for non-degree teacher diplomas. The report recommends a system of "modules" that allows for such students to spread academic courses over a longer period of time "to suit their individual working tempos" (Report 0-31: 276). Here, white student teachers with different mathematical abilities require different pacing. Different mathematical abilities however, do not suggest that they have different abilities to teach. That is to say, the "standard of academic courses" in the training of white teachers, whether they do it over a short period or long period, ensures that they all have the required "qualifications" to teach white pupils. They must all have access to academic and generalised mathematics.

6.4.2.2 Pedagogic and didactical knowledge[2]

The second form of knowledge that is distributed to white teachers relates more specifically to teaching methodology:

> The "how it is to be taught" is the crux of the matter. The Mathematics teacher must have a pedagogically and didactically sound training. He [sic] must have clearly defined aims when he [sic] stands in front of the class. His [sic] preparation must be based on didactical considerations so that situations are mathematised and the pupils can approach the subject intuitively instead of being burdened with countless exercises (Report 0-31:5).

Here there is an emphasis on the pedagogic and didactical knowledge of teachers that is necessary for them to teach in a way that allows their students to approach the subject contents intuitively. In other words, generalised subject knowledge is not sufficient to present contents intuitively to their students. Teachers must also have some "didactical" knowledge. Didactical knowledge refers to knowledge which "presents the educational aspects of the subject concerned" (Report 0-31: 280). There is a suggestion here that the "aims" must attend to the teachers' methodology, that is, "how to teach" rather than on the contents, that is, "what to teach". In terms of the training of white teachers, the report raises as an issue, "bridging the gap between didactical theory and didactical practice" (Report 0-31: 276). It recommends as a solution that trainee teachers be encouraged to prepare lessons according to a lesson scheme or lesson structure, which necessarily "presupposes a didactical theory" (ibid: 277). A lesson structure is adopted from elsewhere and presented as a suggestion of how teachers should be trained to prepare lessons:

> 1. The form of the lesson: In his [sic] preparation a teacher must decide on -
> (a) a basic didactical form (play, example, conversation and/or task);
> (b) a methodological principle (inductive, deductive);
> (c) an arrangement of the subject matter (linear, concentric, chronological etc.) and
> (d) an approach whereby the essential meaning of the new topic is brought home to the pupils whose eagerness to learn has been awakened by confronting them with the new subject matter in a problem situation.
>
> 2. The progression of the actual lesson: This consists of -
> (a) motivating the pupils to apply his pre-knowledge;
> (b) confronting the pupils with a problem connected to their experience;
> (c) exposition of the new subject matter in relation to the problem;

[2] This is a distinction used in the reports to distinguish between subject knowledge (didactical) and knowledge of teaching and children's learning (pedagogic).

(d) controlling to make sure that essence of the new subject matter has been grasped by the pupils;
(e) allowing the pupils time to apply their new insight to related problems, and
(f) evaluation.

(Report 0-31: 278)

In other words, in their professional training, white teachers must receive didactical knowledge which amounts to procedures for structuring of lessons. The procedures attempt to capture the activity of the teacher in the classroom context and assumes a linear progression of lessons. White teachers are positioned at the centre of the pedagogic context. They decide on the form and progress of the lesson; they decide on how the subject matter is to be presented and learnt; they set the pace of lessons and they determine what meaning pupils attach to the contents. To do all of this successfully teachers need didactical knowledge; they need to reconcile their didactical theory with their classroom practice. Their didactical theory informs the form of their lessons, the "methodological principle", the "arrangement of the subject matter", the selection of problems "connected to [pupils'] experiences" and allows them "to make sure that the essence of the new subject matter has been grasped by their pupils".

The recommendation that:

> Lecturers responsible for the Method (Subject Didactics) of Mathematics Teaching Course should have at the very least a Bachelor's degree in Education and an Honours degree in Mathematics (Report 0-29:279).

suggests very strongly that didactical knowledge is specialised knowledge that has to be taught by experts in the field of education. It also implies that decisions white teachers make in the classroom around methodology and arrangement of contents and so forth, should not be based on common sense knowledge, but on sound, "expert" or specialised didactical knowledge. This again contrasts to the constitution of black teachers without specialised knowledge. The report is careful to make the distinction between the distribution of specialised mathematical knowledge and specialised didactical knowledge to white teachers. For example, with reference to the teaching of subject didactic courses the report asserts that :

> [I]t is considered pedagogically unsound to have subject specialists (from the Mathematics Department, for example) presenting the educational aspects of the subject concerned (Mathematics) (Report 0-31: 279).

The argument then is that trainee white teachers are to be taught by subject specialists in their mathematics courses and by subject didactic specialists in their didactic and methodology courses. The subject specialists will come from the mathematics department, while the subject didactic specialists will have "the necessary qualifications in educational theory" (ibid: 279) and will thus be drawn from the education department. An important proviso is that subject didactic specialists should also have "an Honours degree in Mathematics", which suggests that, in addition to their educational expertise, they should also be highly competent in mathematics. The motivation given in the report is that:

> [W]ithout a sound mathematical background lecturers will be unable to inspire their students in the subject (Report 0-31: 280).

While this is a reference to lecturers and student teachers, it is also an indexing of the relationship between white teachers and their pupils. Teacher training must thus ensure that white teachers obtain a sound mathematical background in order to inspire their students in mathematics. Hence the recommendation to give all trainee white teachers access to academic mathematics courses.

6.4.3 Distinction between primary and secondary student teachers

In terms of their suitability for the profession, it is argued in Report (0-31: 276) that all white student teachers must display academic excellence, high moral character, potential for leadership and good religious upbringing. Given these qualities, primary and secondary white student teachers are differentiated primarily with respect to mathematical ability.

6.4.3.1 Primary student teachers

Following the recommendation that the minimum requirement for all primary teaching diplomas should include mathematics passed at matric level, the report

suggests that aspirant primary teachers should take the "Functional Mathematics" syllabuses to Std. 10 level since such a course "aims at stimulating an interest in Mathematics [and] also provides an excellent background for primary school teachers" (ibid: 271). The suggestion is that aspirant primary school teachers are not suited for the academic stream of school mathematics. In terms of their teacher training, it is recommended that mathematics courses for primary teachers be spread over the full duration of the teacher's training course and that their main objective must be to build the teacher's self-confidence in teaching the subject:

> Especially because of the theoretical nature of Mathematics and because a teacher needs confidence in his/her mathematical ability to ensure that the pupils acquire insight into the algorithms taught it is advisable that, as far as possible, the Mathematics courses should last the duration of the teacher's training courses (Report 0-31: 270).

Primary student teachers here are constituted as under-confident in their own mathematical ability and are therefore expected to learn at a slower pace. Nonetheless, they are still expected, at the end of their training, to be able to teach mathematics with insight to their pupils. In particular, they should have insight into the algorithms which they teach pupils. They should therefore have some access to "structure" and the more abstract nature of mathematics. While it is not expected that they do strict university academic mathematics courses in their training, it is expected that their courses comply with first year and second year "university standards". Mostly what this means is that the contents are less academic and may relate more to school mathematics, and that the courses are done over a longer period.

6.4.3.2 Secondary student teachers

The training of secondary student teachers is likened in the report to the training of a "practising mathematician" (Report 0-31: 272). In this regard the report recommends that:

> Mathematics courses for teachers should make provision not only for the learning of mathematical concepts but also for the development of the prospective teacher's ability to undertake mathematical investigations (Report 0-31: 274).

The "ability to undertake mathematical investigations" is described in terms of "techniques which a practising mathematician should master" (ibid: 273), which are quoted from a British report on teacher training. These techniques are quoted and listed as follows:

> (i) Formulating a problem in mathematical terms as well as inventing suitable symbols and/or diagrams.
> (ii) Using existing literature - classifying the problem and so recognising its similarity to problems already solved and bodies of known theory.
> (iii) Breaking down a problem by classifying different cases, ordering them and dealing with them successively.
> (iv) Systematising - collecting a group of results into a logically ordered system.
> (v) Axiomatising - constructing axiom systems for bodies of theory; varying axioms and investigating resulting systems (1,p.15)
>
> (Report 0-31: 273)

In other words, the secondary white teacher is constituted as a subject specialist, who is expected in the first place to follow the academic stream of mathematics at matric level and then to do university academic mathematics courses. The secondary mathematics teacher must have access to mathematics at its most general or abstract level. In relation to the primary student teacher, the secondary student teacher is positioned as dominant with respect to mathematical ability. In the table below I shall summarise postioning and distribution of practices to transmitters.

Positioning and distribution of knowledge to transmitters

	Transmitters		
Positioning in terms of:	**White teachers**		**Black Teachers**
Positioning in terms of:	**Primary teachers**	**Secondary teachers**	
Distribution of knowledge:	- Equivalent degree mathematics courses - Generalised mathematical knowledge -Sound didactical knowledge (educational theory)	- Degree mathematics courses - Generalised mathematical knowledge - Sound didactical knowledge (educational theory)	- Knowledge of mining industry - knowledge of black community - Practical mathematical knowledge

Table 6.1

6.5 Conclusion

The theory of instruction for black acquirers constitutes black transmitters as transmitters with predominantly localised social knowledge. The only specialised knowledge distributed to them is knowledge of conditions in the mining industry, particularly the organisation of workers into "work teams". This specialised knowledge constitutes the specialised pedagogic knowledge for black teachers. Specialised mathematical knowledge is not distributed to black teachers. Within the pedagogic context (re)produced for black acquirers, teaching mathematics with insight effectively means relating mathematical concepts to "practical situations" which black students and teachers are familiar with. Black teachers must therefore have intimate knowledge of local community practices. There is also no differentiation between black teachers - the condition of being black and having knowledge of local social conditions and practices renders them suitable as teachers for black acquirers. Black teachers are thus also constituted as a homogeneous group, whose identity rests upon the identity of the group. The form of social solidarity for black teachers resembles that for black acquirers.

In contrast, the theory of instruction for white acquirers constitutes white teachers as highly qualified transmitters with specialised mathematical and didactical knowledge. They are given access to the most general and abstract levels of mathematics so that they may teach mathematics with insight, which in their case means, making interconnections between mathematical topics and having insight into algorithms taught. White student teachers are to be trained by experts; subject specialists and subject didactical specialists. For prospective white teachers it is not sufficient that they are white; they have to display academic excellence, high moral character, leadership qualities and have a "good" religious background [sic]. While student teachers are differentiated with respect to mathematical abilities, the differences only signal different "learning tempos". Their training must render them all equally qualified, both academically and professionally, to teach white acquirers. Their specialised knowledge and competence in both mathematics and didactical theory constitute them as models of transmitters within a particular theory of instruction, that

is, a theory of instruction that (re)produces specialised competencies for acquirers. In other words, white teachers are equiped with the expertise to deal with differences in white acquirers' abilities and "needs". They are constituted as professionals who can make detailed decisions about the form and progression of every lesson they teach.

It my be argued that black and white transmitters are constituted in a way that is consistent with the positioning of transmitters, in general, as reproducers of pedagogic discourse, as regulators of the pedagogic context and as instruments for change. That is, black and white transmitters are constituted such that they (re)produce and regulate the intended outcomes of theories of instruction for black and white acquirers respectively.

Chapter 7

Recruitment of resources

In this chapter I want to consider the constitution of message in the reports. That is, I want to consider what discourses are appropriated in the positioning and distributing strategies discussed in the previous chapters. The "discourses" are simply statements that have been recruited as resources to establish the positioning and distributing principles in the reports.

7.1 Recontextualising from mathematics and mathematics education

Recontextualising of these discourses are equally concerned with the "what" and the "how" of pedagogic discourse. I shall argue that discourses from mathematics and mathematics education are recontextualised principally to support the proposal for a less academic school mathematics curriculum. It is argued in the reports that school mathematics should be "relevant" and "useful" to the daily lives of students and so it encourages an emphasis on the applied aspects of mathematics.

7.1.1 "Modern" mathematics and "contra-innovation" in Western Europe

Discourses from mathematics and mathematics education which are recontextualised in the reports centre around debates regarding innovation trends in West European countries. The first of these trends is described as the "modernisation"[1] of mathematics syllabuses in the early sixties. Modernisation entailed that "the formal conventional characteristics of mathematical systems were identified and described on the basis of abstract concepts such as sets, relation, group, metrics et cetera" (Report O-29: 35). The didactical motivation for this innovation is described as an attempt to present students with mathematical structures so that they may be given "the universal schemata which govern mathematical thought" (Thom in Report O-29: 35). "Modern" maths of the 1960s was thus characterised by an emphasis in teaching abstract concepts, structures and systems in mathematics and, Report (0-29) argues that, this trend had become outdated and challenged by what is described as a second

[1] It was described as such because it was seen as an attempt to keep up with "progress in the mathematical [and technological] field[s]" (Report 0-29:35).

phase of innovation in Western Europe during the late 1960s, referred to as "contra-innovation".

According to the descriptions in Report (0-29) the "contra-inovation" phase emphasised a need to relate mathematics to other aspects of learners' "reality", including other school subjects. It was essentially a movement protesting the abstract nature of the "modernised" school syllabuses at that time. As such, there were strong motivations for the introduction of practical and applied aspects of mathematics. The report cites at length from papers, by mathematics educators from Britian and the Netherlands, delivered at the 1972 ICME conference. For example, the president of ICME, Lighthill, is qouted as saying:

> [T]he trend in modern[2] mathematics teaching projects in Britian and some other countries has been to give continual illustrations of how the Mathematics taught can be applied. They bring in constantly the concrete example, and are particularly concerned to emphasise the variety of uses and applications of mathematics. [...] I want to suggest that educators may have most benefitted their pupils when they have succeeded in giving a feel for what is involved in the process of applying mathematics. This is the process of building a bridge between the abstract ideas and inferences of mathematics and the concrete problems arising in some field of application (Lighthill, in Report O-29: 37, emphasis in original).

Elsewhere in Report (O-29) the Nuffield Mathematics Project and the Sixth Form Mathematics Project (SMP) are two mathematics teaching projects started in the mid-1960s in Britian, which are discussed in detail and which are marked out as part of the "contra-innovation" movement. Descriptions of their activities are thus presented to underscore the points made above by Lighthill. The methodological approach of the Nuffield project, for example, is decribed as placing an emphasis on the fact that:

> [C]hildren must learn by doing and, as far as possible, by discovering. The task of the teacher is thus to create an "environmnet", inter alia by means of a wide variety of concrete material, amongst which the child may explore, and to intervene when necessary by drawing the child's attention to relevant mathematical aspects of his experiences (Report O-29:24, emphasis in original).

The didactical position of the SMP is described as maintaining the view that "emphasis of the applicability and significance of Mathematics is essential in the instruction in order to guarantee adequate motivation of pupils" (ibid: 27) and, while

[2] "Modern" here refers to "current" rather than the "modern maths" of the sixties.

not rejecting the "modern" mathematics syllabuses outrightly, takes a stand "against stressing the formal structure of Mathematics" (ibid: 26, emphasis in original). Thus in both projects the trend is towards applications and practical experiences in mathematics and less of an emphasis on abstract concepts and structures in mathematics.

Freudenthal, a mathematician and mathematics educator from the Netherlands, is also quoted at length for his views in support of "contra-innovation":

> While I do not urge that the pupil learns applied mathematics, I do wish that he learns how to apply mathematics. This does not mean utilitarianism. Therefore instead of applied mathematics, I would prefer to speak of multirelated mathematics....To teach connected mathematics it is not wise to start looking for direct connections (here Freudenthal differs from Ormell and the approach of the Sixth From Mathematics Project), they should rather be found between the contact points where mathematics is attached to the lived-through reality of the learner (Report O-29:39, parenthesis in original).

Here again there is a de-emphasising of abstract concepts in mathematics and the incorporation of non-mathematical aspects of reality into the teaching of mathematics. It may be argued then that "contra-innovation" is a trend towards making mathematics more meaningful for pupils by presenting mathematics less abstractly. This entails foregrounding the applied aspects of mathematics, providing practical experiences for pupils in mathematics and as far as possible, relating mathematics to familiar non-mathematical contexts meaningfully.

South African mathematics syllabuses of the 1970s are identified in Report (0-29) with those of the "modern" European mathematics syllabuses of the 1960s. That is, they also emphasise abstract mathematical theory. It is clear therefore that the trend towards "contra-innovation" in Western Europe is presented in the reports as current trends and as such, that which is most pertinent to innovation of mathematics instruction in South Africa (in the 1970s). For example, Report (O-29) states in this regard:

> [W]est European mathematicians and Mathematics didacticians at present very much doubt the didactical-pedagogical accountability and effectivity of the initial attempts at innovation (which gave direct cause to the present (new) South African Mathematics syllabuses for the primary and secondary school). It is therefore also noticeable that more recent attempts at innovation such as

> the Sixth Form Mathematics Project, the Mathematics for the Majority project [in Britian] and the projects underway by the IOWO Institute in the Netherlands, break away radically from mathematical modernisation which has become traditional (Report O-29: 40, parenthesis in original).

Here, current SA mathematics syllabuses are produced as "traditional" and not in keeping with current trends in Western Europe which are attempting to move towards more "didactical-pedagogical accountability and effectivity" in their innovations. It is suggested that if there is to be a break from what has become traditional mathematics in South Africa, curriculum developers have to look towards the more recent projects described within "contra-innovation".

A consideration of the suggestions and recommendations made in Report (O-44) and Report (O-75) regarding instruction of mathematics and criteria for the selection and arrangement of topics within future mathematics syllabuses in South Africa, provides some illustrations of how "contra-innovation" trends have been recontextualised to constitute the pedagogic discourse of the reports. Report (O-44) describes, for example, the formative value of the subject-matter, in this case, mathematics, as being:

> [C]losely dependent on the human experiencing of it, that is, on the possibility offered by the subject-matter to form a link with the pupil's world of meaning so that he can assimilate it meaningfully. The syllabus compiler will therefore be obliged to arrange the subject-matter according to its "human experiencing" (Report O-44:111).

Reference to the future instruction of mathematics made in Report (O-75) also resonates with "contra-innovation" discourses:

> The uncertainty as to the nature of Mathematics as a science need not deeply concern those interested in promoting an understanding of the subject to pupils at school level. From an educational point of view the answer to the question as to the nature of Mathematics lies in considering Mathematics from another angle and asking not what Mathematics <u>is</u>, but rather, what does it <u>do</u>. [...] Seeing that pupils should become interested in Mathematics, it is the <u>doing</u> aspect of the subject that should be emphasised (Report O-75:37, emphasis in original)

> Educationalists especially will have to re-examine not only their methods of instruction but also the very foundation on which their instruction is based, namely their concept of the nature of Mathematics, seen not from the point of view of the pure mathematician, but from the the point of view of the teacher who wishes to bring his pupils to a true understanding of the basic mathematical concepts which they can apply in their everyday life (Report O-75:38).

Applicability of mathematics and pupils' experiences of mathematics are thus posited as fundamental premises for the compilation of future syllabuses in SA. With this in mind, Report (O-44) considers the suitability of certain mathematical topics in school syllabuses. For example, "Groups and Fields" is recommended as a topic which should be excluded from future school syllabuses for the following reasons:

> Here one deals with a mathematical topic which can only be meaningfully assimilated with extreme difficulty by the pupil, even in Standard 10. The reason for this is that there is nothing which the pupils have already experienced in their world of meaning which links up to this topic. Neither does this topic prepare the pupils for something which they will be able to comprehend in the foreseeable future (Report O-44:115).

In addition, it is regarded as unsuitable learning content "since [its] application possibilities cannot even nearly be achieved at school" (ibid: 115). In other words, the critera for non-selection of this topic is based upon the extent to which it may be related to non-mathematical aspects of pupils' experiences and the application possibilities it offers. In contrast to the "modern" mathematics syllabuses of the 1960s, the significance of the topic with respect to structure in mathematics in general is not considered.

With respect to the arrangement of topics in future syllabuses, an argument is made for introducing "Trigonometry" before "Logarithms". The motivation given is that:

> [W]hen Logarithms have to be introduced as new subject-matter, there is nothing in the pupil's world of meaning with which Logarithms can be correlated with a view to comprehension by the pupils. The core of the problem is that the pupil cannot relate Logarithms to his world of meaning; he therefore does not experience the new subject-matter as the solution to a meaningful problem which is worth solving (Report O-44:116).

While on the other hand,

> Trigonometry contains problems which may link up directly with the pupil's world of experience. Practical tasks which can be undertaken with pupils, cause no problems to the teacher or pupils and much Trigonometry can be done without any knowledge of Logarithms. At the same time Trigonometry can prepare the pupil and make him ready to understand the new subject matter, Logarithms, meaningfully (ibid: 116).

Here again the argument foregrounds pupils' "world of experience and meaning" as a criteria for both selection and arrangement of topics. There is a suggestion too that meaning can be derived from within mathematics, for example, that logarithms may be understood through trigonometric problems, but trigonometry is privileged because it may more easily be related to non-mathematical aspects of pupils' experiences. In other words, it has wider application possibilities. A similar argument is presented elsewhere in the report for the inclusion of Calculus into future school syllabuses. In the above extract, we also see the recontextualising of "doing and experiencing" mathematics entailed within contra-innovation discourses, into "practical tasks which can be undertaken with pupils".

Recontextualising from contra-innovation discourses is also evident in motivations for the introduction of differentiated mathematics syllabuses which "point to particular post-school vocational fields" (Report O-44:108). The recommendation is that these syllabuses should be compiled "so that pupils may follow a study course on the strength of aptitude and interest which will eventually lead to their fulfilment in a specific occupation after leaving school" (ibid: 108). In other words, selection of syllabus contents are to be closely associated with pupils' post school experiences, that is, experiences outside of mathematics. The following mathematics courses are suggested:

(i) Technical course.
(ii) Commercial course.
(iii) Natural Science course.
(iv) A practical course.
(v) A course in humanities.
(vi) An art course (including music, drama, ballet and the fine arts).
(vii) A home economics course.
(viii) A general course.
(ix) An agricultural course.

(Report O-44:108)

The selection of contents for these courses are expected to be "oriented towards the fields of study" (ibid: 108, emphasis in original). That is, they have to be selected for their application possibilities within those fields of study. The "general course" is perhaps the only course that may attend to applications within mathematics and may

therefore include more abstract mathematical concepts. The other courses, by implication, would necessarily minimise the inclusion of such abstract concepts.

On the basis of the above then, we may argue that recontextualising from "contra-innovation" discourses in Western Europe, establishes distributing principles for white acquirers with an emphasis on a range of mathematical courses that have applied value in varied fields.

7.1.2 Mathematics curriculum development in non-western countries countries

Reports (0-96; 0-75) recontextualise discourses on mathematics curriculum development in Africa and Asia in a specific attempt to find ways to "promote perceptive learning in Black pupils" (Report, 0-96: 56). The argument for recontextualising discourses from these countries is that apparently "[they] have exactly the same problem as exists in the RSA in trying to develop the mathematical potential of their populations, people whose cultural heritage and traditional way of life correspond to that of the rural, and often urban Black people of the RSA [sic]" (Report, 0-75: 50). I shall argue that these discourses are recontextualised to support the proposal that black students should not only be taught different contents to white students, but that they should also be taught differently.

7.1.2.1 Contents

Quoting mostly from papers read at conferences by "Afro-Asiatic delegates" the reports cite several statements that claim that European syllabuses are unsuitable and inappropriate for pupils of "developing countries". The main reason apparently is that the mathematics presented in European syllabuses is too formal and abstract and holds no relevance for the lives of people in developing countries. For example, the following quotes refer to Gambia, India and Africa [sic]:

> "All efforts at giving an education which is purely formal or academic have been increasingly condemned because they give no guarantee at all now of future employment [...] the old educational system, withe the emphasis almost excusively on academic subjects, is *not* the most suitable for developing countries like ours" (M.E Millard, Gambia, in Report 0-96: 57, emphasis in report).

> "The stress [in Mathematics curricula] has been on the "modernisation" of the syllabi and not a great deal of thought has been given to its relevance to the conditions and economy of India" (M. Singh Arora, India in Report 0-96: 57).

> "It is widely recognised in Africa that we must take those natural phenomena, those topics relating to the land, the river, the forest, the desert, and to agriculture, health, and the like, which are deemed to be most suitable for particular children" (UNESCO Report, in Report 0-96: 57).

Implied in these statements is that the economies of "developing countries" make different demands to western countries on the education of their pupils and that the emphasis on abstract mathematics in school curricula do not meet the economic demands of developing countries. However, in equating the "problems" experienced in these countries with the "problem" of teaching black pupils in South Africa, it becomes clear that the comparison is based on an argument that these are all non-white students and therefore they have similar "needs", rather than an argument that the economic demands on South African pupils are the same as those in developing countries. In other words, the reports suggest that black and white pupils in South Africa do not experience the same economic demands on their education and therefore it is only the educational needs of black pupils that are the same as those of pupils in developing countries. On the basis of the above quotes and further similar quotes, Report (0-75: 52), for example, poses the question:

> What then is the solution to the problem of developing the mathematical potential of the Black children and of all children in the developing countries?

At no time is the economy in South Africa and its demands on education compared to those in the developing countries, except for a remark in Report (0-96: 58) that "the countries in Africa also have a great need for economists, industrialists, technicians, physicians and other highly skilled persons to develop their countries properly". There is the suggestion throughout that "blacks" need special training, compared to whites perhaps, to take up these skilled positions. For this reason the reports go on to discuss curriculum programmes geared for black pupils which have been initiated in various countries.[3] They discuss a programme in India which was based on the following guiding principle:

[3] The reports assume, certainly suggest, that the countries they refer to have only black pupils.

> Work experience is to be a highlighted feature of school education at all levels with a view to afford an opportunity to make learning possible by the use of hands, to break the unnatural dichotomy between work and education [...] and to bring the school closer to the community and the community closer to the school by providing a bridge between the life of the scholar and the life of the work (Report, 075: 52, emphasis in report).

Also, the Caribbean Mathematics Project which "did not aim at producing a syllabus of work but encouraged teachers to plan their own curriculum based on the needs of the children which were identified through diagnostic tests" (Report 0-75: 53). A quote from an evaluation report of this project is given as a way of characterising the project:

> We are interested in the kind of mathematics needed in buying fish, in building a house, in making an economic plan (Report, 0-75: 56).

Its emphasis was thus on aspects of mathematics and everyday life and the report draws attention to the many publications from the project which reflected this emphasis. Publications were titled for example, "Making Change", "Getting on in business", "I am a tourist too" and "Tooth House, Our Teeth" (Report 0-75: 54). It is evident in both programmes that the mathematical contents are related to pupils everyday experiences and their future employment and it is suggested that academic mathematics do not serve such educational needs. This apparent emphasis is also mentioned with respect to education in "communist China":[4]

> In communist China children are spending considerably less time on academic study than they did before, yet they work much harder because study and work are combined. Their academic subjects have been shortened but made directly relevant to concrete experience. The general guideline is self-reliance. [...] The local resources and needs determine what each school, farm or factory, produces, but no matter how modest, they are all functional. [...] Chinese leaders have come to realise that academic learning must be relevant to life and contribute to the economic production of the nation with all its millions of people [sic], and they are aiming at technical training as an integral part of education for all (Report 0-75: 55).

[4] It would seem that the selection of China as an example in a discussion of curriculum development in developing countries, is based on the economic organisation of the society. That is, the organisation of society in "communist" countries is closer to that of developing countries than western "capitalist" societies and therefore their educational practices could serve as models for teaching black pupils in developing countries. This reasoning seems to be the case also in Report (0-96) which suggests that the experiences of schooling in the Soviet Union could serve as a model for teaching black pupils in South Africa.

Once again economic needs and "relevant concrete experience" of pupils are priotised over academic learning. Reports (0-75; 0-96) cite a number of other examples to make an argument that pupils in "third-world, "developing" and "communist" countries ("black" pupils) firstly, face different economic demands to pupils in western countries ("white" pupils) and, secondly that their everyday experiences are very different to pupils in western countries and therefore, their educational needs are very different. In particular, black pupils have to be taught different contents and taught in a different way to white pupils. The need to separate black and white pupils is argued forcefully in Report (0-96) under a discussion of desegregated schooling in the USA. Here they cite a number of people who describe the failure of desegregated schooling in terms of differences in "culture" between white and "Negro" [sic] children. For example, there is an argument that in desegregated schools "damage is done to the Negro child's self-image", also, that there is "a loss of racial models, heroes and authority figures for Black children" (Report 0-96: 58-59). Based on these arguments, Report (0-96: 59) asserts that "the Negro in the USA therefore seems to prefer an educational system that has been designed for him [sic] and is controlled by his own people [sic]". The suggestion here is that teaching black and white pupils separately is in the best interests of black pupils. That is, separate education allows for the "special" needs of black pupils to be taken into consideration. These "needs" include their cultural experiences and employment opportunities.

It may be argued then, that discourses on curriculum development in non-western countries establish positioning and distributing principles for black learners that are premised on a belief that black and white pupils have different educational needs. In particular, they assert that black pupils should not be taught academic mathematics, rather, black pupils should be taught mathematical contents that are practical and functional and that relate to their everyday experiences.

7.1.2.2 "Educational practice"

Discourses are also recontextualised to support an argument that balck pupils be taught in a different way. Report (0-96) recontextualises discourses which describe

educational practices that differ from those of "western style" schooling. These are recontextualised specifically to contemplate "an educational practice for the Black nations" which stem "from the Black man's traditional educational style" (Report, 0-96: 62). This style is characterised in the reports as "group connectedness", although the report points out that this is not to be confused with group-education found in Western schools since in these schools group-education "is only implemented occasionally and for short periods" and this, it is argued, "does not comply with the demands made by the Black man's cultural environment" (Report, 0-96: 64). Instead they refer to group-oriented education in the Soviet Union and Japan as more in keeping with what is required for the education of black pupils. The connection between education for black pupils in South Africa and education in the Soviet Union is made on the following "facts":

> Russian society had been so disrupted at a certain stage that the family could not function as the primary socializing entity. A strange [sic] but effective socialising entity which relied on a group-oriented approach was created in the place of the family. It has been intimated in the case of the Black nations of the RSA that the Black man is group-oriented by nature and that his whole socio-cultural structure revolves around integration and co-operation with the extended family unit and not around the individual in family context (Report 0-96: 65).

On this basis then, the educational experience of the Soviet Union is looked upon as "valuable guidelines for an indigeneous Black education". Further reasons for the appropriateness of group-oriented education for black pupils relates to the type of adults this form of education produces. For example, it is argued that in the Soviet Union the form of education "lead to a remarkable sense of co-operation, responsibility and duty among the pupils" and in Japan, group-oriented education was regarded as the "foundation stone of Japan's remarkable economic progress" (Report 0-96: 64). It would seem, that the search for an "indigineous educational practice" for black pupils is motivated by a desire to produce co-operative, responsible, dutiful and productive black adults. However, this desire is apparently secondary to the desire to create an educational practice that is in the best interests of blacks. That is, a practice which is not "alien" but stems from *their* [sic] traditional educational practice. It may be argued then, that discourses relating to educational practices in the Soviet Union

and Japan are recontextualised to establish a recontextualising rule that accepts that black pupils should only receive group-oriented education.

The recontextualised discourses above are used to suggest that white and black pupils in South Africa also have to be taught different contents and taught in different ways. That is, curricula for white pupils should follow the western experience and curricula for black pupils should follow the experiences of non-western countries. For blacks therefore, the reports recommend that they follow "practical mathematics courses" and that these courses must enable them to have basic mathematical skills necessary for some semi-skilled and skilled work. In addition black pupils must be taught only through group-oriented education as this would be to "the mutual benefit of themselves and the RSA" (Report, 0-96: 65).

7.2 Recontextualising from other discourses in the human sciences

Discourses which are recontextualised here are concerned mainly with the questions "how do children [in general] learn" and "how do we teach [in general]". They establish further positioning and distributing principles relating to concept formation, language competence and cultural practices to be considered in the teaching and learning of school mathematics.

7.2.1 Concept formation and learning theories

In its consideration of concept formation in mathematics, Report (O-75) draws heavily on theories from psychology, in particular, the work of Piaget, Lovell and Skemp. The report adopts a basic assumption regarding the learning of mathematical contents:

> Mathematics is par excellence a sequential learning subject. By this is meant that new content cannot be fully grasped unless there is insight into and understanding of the previous basic content matter (Report O-75:21).

Learning of mathematics is thus thought to happen sequentially and in stages. It is not surprising therefore that Piaget's stage theory and basic mathematical principles which children must grasp, are elaborated in detail as a definitive way of

understanding "the stages of conceptual development in children" (Report O-75:22). The report justifies its recontextualising of Piaget's theory on the basis that it "has been widely accepted to this day" (ibid: 29) and according to a quote from a UNESCO report on mathematical concept development:

> Studies in a variety of cultures give support to the proposition that at least the major aspects of Piaget's theory can be applied to all human societies. This degree of generalisability has not been established for any other theory of human intelligence (Report O-75:29)

Piaget's theory of mathematical concepts which he describes as being basic to the understanding of mathematics is thus regarded as universally applicable. These concepts include concepts of number, time, length, measurement, area, volume, substance and weight. The report however does not entirely endorse his theory of how concepts are acquired:

> His theory as to the manner in which these concepts are acquired by the young child has, on the other hand, come in for much criticism especially his theory of specific stages and sub-stages through which children are supposed to develop (Report O-75:29)

Also,

> When it comes to the problem of furthering the mathematical ability of children his work lends itself to a great deal of fallacious inferences not intended by Piaget himself (ibid: 22, emphasis in original).

There is thus some circumspection about using Piaget to assert how children learn or how they should be taught. It is used rather to assert what should be basic to children's mathematical knowledge. In terms of how concepts are formed and how children can be taught to form concepts, the report draws particularly on Lovell and Skemp. It is evident that their work has been recontextualised particularly for the emphasis they place on the relationship between concept formation and children's experiences. Lovell's theory of concept formation maintains that "varied experiences involving actual acquaintance with objects and situations, are necessary" (Report O-75:26) and that concepts are formed when a person dissociates him/herself from a particular experience after "necessarily [having] reached a certain level of maturity" (ibid: 27). His theory thus also assumes developmental stages, although for him

levels of maturity differs from child to child and so they are not articulated as rigidly as Piaget's developmental stages.

Skemp's definition of "schema" is used to explain what is meant by "understanding":

> Skemp defines [schema] as follows: "To understand something means to assimilate it into an appropriate schema". The implication of this statement is that the schemas built up in the initial learning or early experience of a subject will determine to a great extent the ease or difficulty with which related topics are mastered later on (Report O-75:29).

Again we see the emphasis on children's *experiences* of the subject and also how Skemp's theory is used here to support the basic assumption that mathematics is a "sequential learning subject". These theories of cognitive development in children are recontextualised into a pedagogic discourse that asserts among others, that:

> On the whole the child moves from the concrete to the abstract in his intellectual development (Report O-75:27)

And,

> In explaining new concepts, the teacher should be well aware of the level of his pupils' field of experience as the basis on which he must build up new concepts and form new schemas. He has to plan well ahead to decide which schemas will be the most adaptable to future needs as well as satisfy the requirements of the present (ibid: 29)

Students' experiences in the mathematics class is also privileged in the reports when discussing future training of mathematics teachers in SA. For example, Report (O-31) suggests that a "pedagogically and didactically sound training" should allow teachers to prepare lessons "based on didactical considerations so that situations are mathematized and the pupils can approach the subject intuitively instead of being burdened with countless excercises" (Report O-31:5). It also recommends a lesson structure which trainee teachers could use to prepare their own lessons. Within this structure, a mathematics lesson must start with motivating pupils "to apply [their] pre-knowledge" and then "confronting pupils with a problem connected to their experience" (Report O-31:278).

Recontextualising from psychology and theories of cognitive development is consistent with the recontextualised discourse of contra-innovation in so far as they emphasise that new learning contents is best learnt if presented through situations or contexts which are familiar to students so that may build on existing concepts by engaging with the subject intuitively and concretely. It is also consistent with the recontextualised discourses from non-western countries that assert that the experiences in these countries are different to those in western countries and therefore curricula have to be adapted to suit their contexts. Implicit in recontextualisings from contra-innovation and cognitive development discourses are recontextualisings from prevalent learning theories. In this regard, learning and thinking is assumed to develop out of feelings of "curiosity or astonishment about a specific object, matter or problem situation" and the need to "understand and gain insight into the new situation" (Report O-75:33). The teacher is constructed at the centre of the learning environment wherein he/she must pay careful attention to the planning of these "problem situations" through which pupils' learning and thinking can develop. Learning and thinking are viewed very much as results of individual actions and entail much more than the formation of relevant concepts:

> The forming of concepts gives rise to a further most important aspect, namely the personal relationship or stance which the learner takes with respect to the problem he [sic] has resolved. He [sic] unconsciously evaluates his new knowledge in terms of what it means, or could mean, to him (Report O-75:34).

And,

> The importance the learner has attached to the problem situation into which he has acquired insight, leads him to a smaller or greater extent to surmount the whole field opened by his insight and solution of the problem, and to master the problem itself through repetition (ibid: 34).

In other words, learning is also about developing a certain "stance" to the subject, a stance that develops out of personal meaning a learner may derive from a problem situation. This supports the position that problem situations have to relate closely to pupils' "everyday activities" in order for them to derive personal meaning from the solution to such problems. We see then that recontextualising from learning theories maintains a discourse that privileges everyday experiences of pupils as a way of

introducing new concepts and building on old ones. It is also consistent with a discourse that privileges the applied value of mathematics. Above all, these discourses establish positioning and distributing principles for the "normal" child. These are used to compare black and white acquirers, with ideal white learners (re)produced such that they may be recognised as "normal" while the black acquirer is pathologised and (re)produced as "abnormal".

7.2.2 Language and thought

In their recontextualisings from psychology and other learning theories, language acquisition is closely associated with concept formation. It is asserted for example, that:

> Through language a person is able to dissociate himself [sic] from his surroundings, symbolise his experiences and reflect upon them, all the time moving away from an affective (emotional) relationship to a more cognitive one. It is obvious that when Mathematics is undoubtedly the subject of abstract reflective thinking, language attainment will necessarily influence the development of Mathematics concepts to a great extent (Report O-75:40).

Language is assumed to be the medium through which thought is expressed and simultaneously, the vehicle for thought. The relationship between language and thought is raised particularly with reference to language as a "cultural heritage" and in the context of second language learners. Fluency in a mother tongue language is deemed crucial "for the development of logical thought and for the development of the social and emotional life of the child" (ibid: 41). Such a statement would seem to be particularly pertinent within the multi-lingual context of SA. It is significant therefore that difficulties with regard to mother tongue instruction in mathematics is raised only with repect to "African language" learners. Here "African language" is defined as that which "the Black man" speaks and which is not "one of the official South African languages" (Report O-75:41) and so excludes English and Afrikaans as "African languages".[5] "African" languages as mediums for instruction are said to have several disadvantages, which include not having "the necessary mathematical scientific and technical vocabulary", "lack of academic textbooks written in the

[5] English and Afrikaans were the only official languages at that time.

mother-tongue", that the languages "do not offer their users the opportunity of comminucating with people of Europe or other peoples of Africa even [sic]" and that "the languages of commerce and industry are the official languages of the RSA[6]" (ibid: 41). While similar disadvantages could be related to Afrikaans as a medium of instruction, it is clear that the relationship between language and thought is used in particular to motivate that "African" language speakers become fluent in either English or Afrikaans in order to learn mathematics effectively. These two languages are obviously regarded as compatible with European languages and are deemed to be the only appropriate languages in the SA context, through which mathematical thinking can develop. In other words, language is a vehicle for mathematical thinking only if the language itself is "appropriate" and has the "necessary scientific vocabulary". More specifically, English and Afrikaans are the only appropriate languages for the instruction of mathematics. These discourses clearly establish principles that position black acquirers as subordinate to white acquirers.

7.2.3 "Cultural" theories

Pedagogic discourse in the reports is further constituted through recontextualisings from discourses which describe learning as "culturally determined". Some of the assumptions that arise from recontextualising of these discourses is that learning is dependent on "heriditary factors" and that "different ability patterns exist among different cultural groups":

> The rate of development of every person's potential, that is, his maturation, depends largely on heriditary factors, but also to a great extent on the milieu and culture (especially the educational milieu) in which he finds himself. [...] Consequently the cultural group and milieu in which a child grows up have a determining effect on the contents and quality of the child's concepts, which implies that different ability patterns exist among different cultural groups (Report O-96:4).

We find then that concept formation and language acquisition, as part of the learning process, are related to "cultural" aspects of children's upbringing. "Cultural differences" which are discussed include their material conditions, social relations within the family and the meaning that cultures attach to existence and co-existence

[6] That is, English and Afrikaans.

and to the concepts of individuality, time and space. These aspects are considered significant in determining the "what" and "how" of peadgogic discourse for different cultures:

> The learning content should not only be chosen so that it stems from his [sic] life-world and culture, but *the teaching process should also be in harmony with the way in which the child was brought up from his earliest years* (Report O-96:22, emphasis in original).

In other words, the reports propose not only that different cultural groups should be taught different contents, but also that they should be taught differently. The reports identify, discuss and contrast only two "cultural groups" and their practices, namely, "White, European" culture and "Black" culture. It is evident from the distinction between these two groups, that "culture" takes on the same meaning as "race", so that "cultural differences" come to mean the same as differences between "races", that is, differences between "Whites" and "Blacks". We may argue therefore that discourses from cultural theories are recontextualised into a racist discourse that proposes that "Whites" and "Blacks" be taught different contents and that they be taught differently.

7.3 Summary and conclusion

This chapter concludes the analysis of the reports. I have attempted in the analysis chapters to produce descriptions of the voice typography and the distribution of message across voices. Using Dowling's (1995) language of description I have described positioning and distributing textual strategies as well as the resources which they recruited, to constitute voice and message in the reports. I have argued that the fundamental positioning and distributing principle is a racist principle that constitutes black acquirers as "other" and subordinate to white acquirers. It was argued further that on the basis of this racist principle theories of instruction that constitute different modalities of practice are (re)produced for black and white acquirers. These theories of instruction further inscribe models of black and white transmitters and models of pedagogic contexts.

The analysis of the reports has also facilitated my reading of current curriculum documents. That is, it has provided a framework within which I may describe models of transmitters, acquirers and pedagogic contexts (re)produced in current syllabus documents. This will be briefly discussed in Chapter 8.

Chapter 8

Discussion and conclusion

The analysis of the HSRC reports set out in the previous chapters provides a framework within which a systematic analysis of the present school mathematics curriculum could be undertaken. This, however, is not my intention here and all that I intend to do at this stage is to highlight similarities and salient differences between the reports and the current curriculum which could provide the focus for future research. I shall start this chapter with a summary and discussion of the analysis of the HSRC reports. I will then move on to discuss the newly implemented (1996/7) WCED[1] Junior Secondary mathematics syllabus document. This document sets out the contents and aims and objectives for the teaching and learning of school mathematics at the Junior Secondary level. The discussion will highlight similarities and salient differences, with respect to acquirers, transmitters, mathematics and pedagogic contexts, (re)produced in the reports and the new syllabus document. I shall conclude with some thoughts on curriculum in practice, as opposed to the written curriculum, and some suggestions for future research.

8.1 Adopting a theoretical orientation and methodology

In Chapter 2 I pointed out that studies on school mathematics curricula in South Africa have tended to focus on analyses of school syllabuses implemented in schools from the white education department. This focus is not been surprising given Julie's (1990) outline of the bureaucratic processes of curriculum implementation in the country, where non-white education departments have made only superficial "adaptations" to "white" syllabuses for implementation in non-white schools. The studies which have analysed syllabuses implemented in white schools have, not surprisingly, all conclude that these syllabuses serve the interests of the white minority group in the country and disadvantage any other "population groups" who

[1] Western Cape Education Department

use the same syllabuses. These studies could be characterised as primarily content analyses which are undertheorised and rarely focused on sociological aspects of school knowledge. Their analyses are most often based on differential distribution of resources based on race classification and the authors' own perceptions of the "needs" of other racial groups. The critiques are thus levelled at "relevance" of contents, availability of resources to implement syllabuses and assumptions about language competency of learners. The literature survey on curriculum studies illustrated that production of school knowledge is a highly contested arena and that social interests are served in a variety of ways through the legitimation of what counts as school knowledge. Since this was my interest I undertook a brief review of perspectives on the sociology of school knowledge in an attempt to develop a theoretical orientation to analysing the reports.

I will recount the main points from this review that informed my own theoretical orientation. Firstly, there was the perspective that curriculum knowledge is inextricably linked to power relations, in that what is reproduced and whose interests are served may always be related to power relations external to itself. Furthermore, these power relations could be explored by examining different domains of practice within the field of curriculum production and reproduction. The first task of my analysis then was directed at establishing the status and positioning of the reports within this field and drawing conclusions about power relations as they related to the construction of curriculum proposals in the reports. It also enabled me to comment on the relationship between the ORF and PRF in South Africa.

Further perspectives on curriculum knowledge production and reproduction described school knowledge as the production of discourses that embodied meaning and social relationships. This implied that school knowledge inscribe teachers and learners in social practices thereby constituting them as subjects of a discourse. Adopting this perspective motivated the analysis to examine what and how subjectivities are constituted for teachers and learners through the curriculum proposals in the reports. Dowling's (1995) language of description for analysing social activity was thus adopted for this analysis by pointing it towards non-pedagogic texts. His model

provided a way of reading texts as material instances of activity whereby specialised practices and subject positions structured by the activity are (re)produced as message and voice in texts. School mathematics as the activity at the structural level of analysis was understood as pedagogic discourse around the teaching and learning of school mathematics. Voices in the text included teachers, learners, bureaucrats and academics. Knowledge and practices that constituted message distributed to them, related to mathematical knowledge, pedagogic knowledge and curriculum innovation practices. The resources recruited to establish positioning and distributing principles entailed the recontextualising of statements from other discourses. Hence the analysis considered also what discourses/statements were recontextualised to support the positioning and distribution of practices to particularly, transmitter and acquirer voices.

My use of Dowling's (1995) language has restricted the analysis to considering only message and voice in the texts. Consequently, there are many more aspects related to both school mathematics practices and methodological issues which have not been explored. For example, I did not explore issues relating to the research methodology in the HSRC reports; I did not discuss "research trends" referred to in Report (0-71); I did not consider textual resources like narrative vs segmental structuring of texts, nor did I consider issues of assessment discussed in the reports. The analysis is thus necessarily selective and no claims are therefore made that the analysis of these research reports is exhaustive.

8.2 Discussion of analysis of HSRC reports

The discussion here will focus on the significance of the (re)production of different theories of instruction for black and white acquirers in the context of the broader social and political organisation of South African society. In Chapter 7 I argued that a racist distributing principle was used to establish different theories of instruction for black and white acquirers. I argued in Chapter 5 that the theory of instruction (re)produced for white acquirers ensured a form of organic solidarity based on specialised performances by individual acquirers. This was in contrast to the theory

of instruction (re)produced for black acquirers that ensured a form of mechanical solidarity based on shared competences and the essentialising and homogenising of the black acquirer. I argue that the (re)production of organic solidarity for white acquirers and mechanical solidarity for black acquirers is consistent with the (re)production of official pedagogic discourse that expresses dominant principles in the society at that time. That is, it was consistent with the position of white dominance and black subordination in the broader society in South Africa in the 1970s.

Firstly, mechanical solidarity is associated in Durkheim (1984) with *repressive law* in society. He suggests that "similar to" relationships upon which mechanical solidarity rests are easily determined and therefore easily controlled. In the reports for example, "similar to" relationships for black acquirers are established through the essentialising and homogenising of the black acquirer, thereby ascribing shared competences to all black acquirers. These include cultural practices and beliefs, dispositions to learning, as well as career trajectories. Individual black acquirers are subject to the authority of some "collective consciousness", in this case, "being black". Durkheim argues that with mechanical solidarity, individuals do not act in their own personal interests, but pursue only collective ends. Under these conditions members of the group "are not only attracted to one another because they resemble one another, but they are also linked to what is the condition of existence of this collective type, that is, to the society they form when they come together" (Durkheim, 1984: 60). Repressive law acts on such individuals by prescribing their conditions of existence. Repressive law is effectively masked in the reports through the production of a theory of instruction that prescribes conditions of existence for blacks. For example, black acquirers are (re)produced so that they will form a collective at the most constraining levels of the division of labour in society. In other words, the theory of instruction for black acquirers is geared towards strengthening the lowest stratum of the labour market. At the same time, Durkheim argues that the cohesion of groups around mechanical solidarity is fairly weak in that individuals may move in and out without affecting relationships within the group. This means that while some blacks may move to occupy higher levels in the division of labour, the lowest levels will remain

unaffected, that is, with this theory of instruction in place, black acquirers will still cohere to occupy the lowest levels of the labour market.

Organic solidarity on the other hand is associated with *restitutive law*, what Durkheim describes as "co-operative law with restitutory functions" (Durkheim, 1984:83). Such law attempts to accommodate individual differences and at the same time to strengthen the cohesion of the group. Durkheim's (1984:83) metaphor is perhaps most illustrative of restitutive law:

> In the end this law plays a part analogous in society to that of the nervous system in the organism. That system, in effect, has the task of regulating the various bodily functions in such a way that they work harmoniously together. Thus it expresses in a very natural way the degree of concentration that the organism has reached as a result of the physiological division of labour.

White acquirers are (re)produced as individuals on the basis of specialised performances. These differences are celebrated in the reports to the extent that they enable white acquirers to enter a complex division of labour in society that relies on a range of skills and performances. In such organisation of society specialised performances are regarded as complimentary to each other, with each one contributing to the well being of the whole society. While the form of solidarity is low, it does create greater cohesion of the group since members are now interdependent for a range of skills and performances. In this sense organic solidarity for white acquirers produces greater cohesion amongst whites within a complex division of labour in society. Organic solidarity for white acquirers can thus be seen to resonate with the political mood at that time to maintain the class dominance of whites in the broader society. We may argue therefore, that theories of instruction that constitute mechanical solidarity for black acquirers and organic solidarity for white acquirers is consistent with the dominant principles in South African society in the 1970s. They do not disrupt the social relations in the broader society, in fact they work towards creating wider social differentiation between blacks and whites, thus entrenching the class dominance of whites within the social division of labour.

Given the difference in theories of instruction for blacks and whites, it is significant that Report (0-75:3) points out that the research was undertaken with the assumption

that "all people of normal intelligence, irrespective of race, colour or creed, are endowed with a certain basic mathematical ability which can be cultivated", yet, differentiating mathematical abilities of students on the basis of IQ did not extend to black pupils. It may be argued that if IQ were used as a basis for differentiating all learners, black and white acquirers could potentially be spread across all levels of ability. If that were the case there would have been less regulation on the social mobility of blacks and segregation on the basis of race would have been more difficult to contain. This in turn would have contradicted or challenged the dominant principles in society. At the same time, the rhetoric demanded that differentiation explicitly on the basis of race be eradicated and so we find in the reports, "race" being displaced by "culture" and "IQ" as the principal reason for producing different theories of instruction for black and white acquirers. For black acquirers, it was not IQ, but their "culture" that determined their potential, their ability, their learning readiness, their course of study and their careers. For white acquirers, it was IQ. "Culture" and "IQ" were used to mask differentiation fundamentally based on race. This was effectively done through the recontextualising of discourses to constitute different theories of instruction for black and white acquirers. In this way, not only could segregation be maintained, but also social divisions could be strengthened through the production of different forms of social solidarity for blacks and whites.[2]

It is of interest to ask now, within the present context of political transformation in SA, what are the differences and to what extent do the curriculum proposals in the reports resonate with how learners and teachers, and the social relations between them, are constituted in the new mathematics syllabus? This will be considered in the next section where I shall briefly discuss a current syllabus document within the framework developed for analysing the reports.

[2] Bearing in mind that repressive law based on racial oppression and exploitation was, during this time, coming under increasing pressure from the oppressed as a well as international communities, it may be argued that the curriculum proposals in the reports were an attempt to maintain symbolic control in a context of fragile political control. The influence of MASA in initiating the research into mathematics education and the compliance of the HSRC to such a request may be read in this context.

8.3 Discussion of a 1996/7 syllabus for mathematics

The analysis of the HSRC reports highlights certain aspects of the teaching and learning of school mathematics in South Africa that brings into special focus certain features of the current curriculum. This discussion will thus focus on salient features which the analysis of the reports have enabled. I refer in particular to the positioning of teachers and learners and the distribution of knowledge to them. The analysis of the research reports has thus facilitated a way of reading the current curriculum and enabled some speculative comments on the present. In the discussion below I will focus on the 1996/7 WCED[3] Junior Secondary syllabus for mathematics.[4]

8.3.1 Background to 1996/7 syllabus for mathematics

Political changes initiated in 1990 heralded a period of transformation in all facets of South African society. This reached a climax with the first democratic general election held in 1994. The restructuring of education saw the dismantling of racially separate education departments into a single national education department administered locally by provincial education departments. This restructuring was accompanied by education policy statements that called for a redressing of inequalities in education. One strand of inequality identified related to what counted as legitimate knowledge in school curricula. This seemed to be motivated, in part, by the idea that differentiation between people and differential distribution of power had been maintained in the past by the constitution and reproduction, through education, of boundaries between different forms of knowledge and practices. Changes in education thus included a reconceptualising of the structuring of school curricula. In particular, there were strong motivations that the democratising of education required "integrated" curricula which rejected the distinction between academic and non-academic practices:

> An integrated approach implies a view of learning which rejects the rigid division between "academic" and "applied", "theory" and "practice", "knowledge" and "skills", "head" and "hand".

[3] Western Cape Education Department - one of six provincial education departments in South Africa.
[4] There were two issues, in July 1996 and January 1997, with implementation dates for standard 5: January 1996; standard 6: January 1997 and standard 7: January 1997.

> Such divisions have characterised the organisation of curricula and the distribution of educational opportunity in many countries of the world, including South Africa. They have grown out of, and helped to reproduce, very old occupational and social class distinctions. In South Africa such distinctions in curriculum and career choice have also been closely associated in the past with the ethnic structure of economic opportunity and power (Department of Education, 1995: 15).[5]

The argument suggests that integrated curricula will overcome the differential distribution of social and economic power along the lines of class and race. In practice, integrated curricula mean that everyday knowledge and experience of students became important components of the curriculum, not only as resources, but as valid knowledge in their own right.

The restructuring of education included consultative processes for the rewriting of curricula at provincial level only. At national level, despite attempts to democratise education, the process of curriculum change has remained a "top-down" process. National core curricula implemented in 1994 were relatively unchanged syllabuses implemented in white schools since 1990/1.[6] In other words, "new" curricula were really only new to black schools. These core curricula were subject to provincial modifications. This permitted provincial education departments in consultation with teacher unions, professional associations and NGOs, to expand on the core curricula by adding syllabus contents and methodological details. Here, contents were not allowed to be omitted from provincial syllabuses. The provincialised syllabuses implemented in 1995/6/7 thus still bear a strong resemblance to the 1990/1 syllabuses implemented in white schools. The most visible differences relate to new societal aims and some expansion of principles and general aims of teaching and learning, but specific aims of mathematics education remain relatively unchanged since 1990/1. The WCED syllabus for Junior Secondary is an example of a provincialised syllabus for mathematics. In the discussion which follows I will consider positioning and distributing strategies with respect to transmitters and acquirers as well as the nature of the pedagogic context (re)produced in the document. These will be compared to theories of instruction and models of transmitters and acquirers, constituted in the HSRC research reports.

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[5] That is, National Department of Education.

[6] From the descriptions which follow, it appears that these syllabuses incorporated many of the curriculum proposals for white acquirers in the reports.

8.3.2 Positioning and distribution of practices to acquirers

Ideal acquirers here are again textual subjects inscribed in pedagogic discourse. In the *principles* of the syllabus document, acquirers are described as "active participants" in the learning situation:

> The pupil comes to the learning situation with his/her own existing knowledge built up of his/her previous experience, and new ideas are understood and interpreted in the light of the pupil's existing knowledge. The pupil is therefore not a passive receiver of knowledge, but an active participant who learns by re-organising and re-structuring his/her present knowledge structures, and this can only be done by the pupil himself or herself (WCED, 1997: 2).

Acquirers are constituted as already knowing, autonomous learning subjects capable of achieving meaningful understanding of new ideas independently. Even though there is reference made to a "range of pupil abilities", pupils are not positioned hierarchically according to ability. Rather, equivalent relations are set up between pupils whereby they "learn from each other (and the teacher) through discussion, communication and sharing of ideas, by actively comparing different ideas, reflecting on their own thinking and trying to understand other people's thinking by negotiating a shared meaning" (ibid: 2). Acquirers are thus constituted as always competent individuals and differences between pupils are seen as potentially complimentary rather than being a hindrance in the learning situation. There is also a less visible hierarchical relationship between pupils and teachers in that pupils are said to learn not only from teachers, but also from each other. The teacher in other words, is not positioned as the only expert voice in the classroom; learners must be given opportunities to share *their* ideas, opinions and learning strategies which are equally valued.

As autonomous learning subjects, acquirers are encouraged to develop a wide range of individual learning strategies by engaging with "mathematical processes" such as "comparing, classifying, describing, representing, pattern searching, inferring, analysing, proving and problem solving" (ibid: 2). It is expected that this will result in "flexible" learners who are able to decide for themselves on suitable strategies for solving problems, on the reasonableness of results and are able to make conjectures

based on their observations of patterns. For example, with respect to the use of calculators, the syllabus recommends that " pupils should use their own discretion in deciding when to use the calculator" (WCED, 1997: 21) and, with respect to number patterns, pupils are expected to make hypotheses and then generalise or prove them. One of the *specific aims* in the syllabus also describes independent decision making expected of learners, where they must be able to:

> recognise a real-world situation as amenable to mathematical representation, formulate an appropriate mathematical model, select the mathematical solution and interpret the result back in the real-world situation (ibid: 4).

Learners are thus constituted as independent, thinking individuals capable of making their own learning choices. They are to be encouraged "to explore", "to investigate", "to describe", "to estimate", "to convince themselves, intuitively" and so forth. Differences between individuals are celebrated to the extent that they are seen to contribute to "learning as a social process" with opportunities for learners to share ideas and negotiate shared meaning and to develop individual learning strategies. The syllabus further recommends that assessment strategies be varied and "flexible", so as to "cater for individual differences" but also to recognise that "not all worthwhile learning experiences need to be assessed for marks" (WCED, 1997: 13). In other words, assessment should also "motivate and support the learner" to develop at his/her own pace. There is however no suggestion of different mathematical courses to be followed by students of different abilities. That is, acquirers are constituted as (potentially) equally competent and should therefore all "experience success in learning" and "be encouraged to progress further" (ibid: 13). Learners in the new syllabus are thus undifferentiated. In this sense, it may be argued that social mobility for acquirers hinges on the mobility of the individual to occupy any position in the general division of labour: choice of "future study and careers" (ibid: 4), is open and accessible to all. Differences between individual acquirers are about developing learning strategies and pace of learning, and not about differences in potential to learn or to follow future careers. Assessment criteria further constitute highly individualised positioning strategies. For example, acquirers are to be assessed on:

- academic competence (e.g. to what extent has the pupil understood the mathematical concepts involved; does s/he display creative and independent mathematical thinking and the ability to employ a wide range of strategies for problem solving);
- social competence (e.g. does the pupil participate constructively in class; does s/he display leadership skills; is s/he articulate etc.);
- practical competence (e.g. can the pupil present work attractively, manage construction tools effectively etc.)

(WCED, 1997: 14).

Individual differences between learners are not explicitly linked to differences between communities or "cultural practices" of learners. There is thus no distinction between black and white acquirers, nor any suggestion that blacks and whites have different dispositions to learning. The *societal aims* of the syllabus are clearly directed at overcoming any racial differentiation that existed in the past. For example, the societal aims are:

2.1.1 to work towards the reconstruction and development of South African society and the empowerment of its people;
2.1.2 to develop equal opportunities and choice;
2.1.3 to contribute towards the widest development of the society's cultures;
2.1.4 to encourage democratic, non-racial and non-sexist teaching practice;

(WCED, 1997: 3).

Mathematics, in other words, is to become a vehicle for overcoming social differentiation by (re)producing "independent, confident and self-critical citizens" (ibid: 3) with strong individualised identities, based on personal capabilities and self-interest. This is in contrast to the curriculum proposals in the reports where mathematics is a vehicle for maintaining social differentiation; black and white acquirers are differentiated and through mathematics, they are acculturated into their respective "communities" and social class groups. In the current syllabus, individual acquirers are undifferentiated and are not constrained by the practices of racially defined "communities". Mathematics is to serve as a resource for individual social mobility that seemingly transcends race or class barriers. Although one of the *general teaching and learning aims* is "to contextualise teaching and learning in a manner which fits the experience of pupils" (ibid: 2), there is no elaboration of what the

differences in these experiences might be, nor any suggestion that these experiences predispose learners to learn in certain ways.[7]

In both the syllabus and the HSRC research reports, acquirer voices are objectified voices, but, unlike the reports, the acquirer voice in the syllabus is positioned as a potential apprentice voice. It is constituted as an independent, autonomous and competent voice. While the theory of instruction individualises learners, learners are not positioned hierarchically in relation to each other. They are undifferentiated and positioned as potentially equivalent voices. The theory of instruction encourages multiple acquirer voices in a "co-operative learning environment" (WCED, 1997: 4). Rather than establishing hierarchical differences between acquirer voices, the theory of instruction strives towards overcoming differences by establishing shared meaning and relations of interdependence within the pedagogic context. In other words, acquirer voices are constituted as interdependent, autonomous voices. It may be argued therefore that the theory of instruction (re)produces acquirers who will become independent thinking citizens capable of living and working co-operatively within the broader society, where social mobility hinges on the mobility of the individual rather than class/race mobility. Social relations within the pedagogic context is thus to be sustained through relations of interdependence. It may be argued that in this way, the theory of instruction will achieve its societal aims of "developing equal opportunities and choice" and "contributing towards the widest development of the society's cultures". In other words, *the rhetoric of social equality is matched in a rhetoric of equality in acquisition.* All acquirers are potential adepts. From another perspective, it may be argued that the societal aim of "working towards the reconstruction and development of South African society and the empowerment of its people", is achieved through the constitution of a theory of instruction that (re)produces a model of the pedagogic context which is to be sustained by organic solidarity and constitutes acquirers that could inhabit a complex division of labour in society. Society is to be

[7] There is thus some ambiguity about whether "contextualising teaching and learning" means that learners' experiences determine what mathematics is suitable for them to learn, or whether it means that learners' experiences are used as resources to enhance individual sense-making so as to provide access to further mathematical thinking. This decision it seems is left to the interpreters of the syllabus, that is, to teachers.

maintained by relations of interdependence. Furthermore, organic solidarity ensures that relations of difference are regulated such that they maintain a strong cohesion of the society as a whole.

The form of social solidarity constituted for acquirers in general in the new syllabus clearly resonates with that constituted for white acquirers in the HSRC reports.[8] However, in the reports there is a clear hierarchising of acquirer sub-voices on the basis of IQ and personal attributes. IQ, as a measure of individual competence is not referred to in the new syllabus. The assessment criteria however suggest that personal attributes and abilities do contribute to the competence of individuals. In other words, since IQ, assumed to be innate, is no longer a measure of competence, competence will be based purely on a host of interrelated performances by individuals. It was argued that the pedagogic context for white acquirers was constituted in terms of organic solidarity and the theory of instruction prepared acquirers for careers within a complex division of labour in society. This, it was argued, was consistent with the dominant position of whites in the broader society in the 1970s. As far as white acquirers are concerned then, the 1996/7 syllabus does not set out to disrupt existing social relations: individual differences are celebrated to the extent that they enable acquirers to occupy a range of positions in the general division of labour. Since the syllabus does not differentiate learners, black acquirers are no longer "marked" or positioned as a subordinate group to white acquirers. They are effectively to be co-opted into a system of social relations established initially for white acquirers only. Black acquirers are to be marked out as individuals in the same way as white acquirers have been. That is, they have to be read in terms of their personal attributes and career interests, which may vary from acquirer to acquirer. In this sense, relations of equivalence are established between black and white acquirers. Individual identities are to dominate over group identities, which means that there is explicit marking out of black acquirers. Social relations, for all acquirers and in general, are to be described in terms of organic solidarity.

[8] This is not entirely surprising since the provincialised syllabus is based on a core syllabus which was implemented in 1990/1 in white schools only.

It may be argued that the new syllabus is consistent with the rhetoric of a racially undifferentiated society. At the same time, if one considers social relations described in the syllabus in the context of the broader South African society, it may argued that organic solidarity is consistent with a South African society in which class differences remain pronounced. In other words, social relations in the broader society is also sustained by relations of interdependence that constitute class relationships. The new syllabus may thus be interpreted to mean that more blacks must be made available to occupy positions in a complex division of labour in society. For black acquirers, this would mean that they would have to assert their individuality in order to ensure social mobility. All acquirers in the new syllabus are constituted as potentially competent, and they have to learn to display their competence through certain privileged performances, for example, being articulate, being able to reflect on their own thinking, using a variety of learning strategies and so forth. Their identities no longer rest upon the racial communities from which they come; they have to develop individualised identities based on their own self-interests rather than those of their communities. The theory of instruction which encourages all acquirers to follow their self-interests (re)produces individuals who can occupy a wide range of positions in the general division of labour in society. Mathematics is to serve as a resource to achieve this. In the new syllabus, the theory of instruction attempts to give previously disadvantaged and oppressed black acquirers some assurance of access to previously "privileged" positions in the general division of labour, while maintaining such access for white acquirers. While it might be argued that this is appropriate in the context of "reconstruction and development" in South Africa, it is clear that the existing dominant class positions in the society is hardly threatened. In effect then, the new syllabus is a mechanism for ensuring that at least some black acquirers will join white acquirers in occupying dominant positions in society. In particular, those black acquirers who display certain privileged attributes and performances. In this way, a complex division of labour in society, sustained by organic solidarity, is (re)produced rather than a racially stratified society, sustained by mechanical solidarity. It may be argued that, while the new syllabus does not use race explicitly as a resource for social differentiation, potentially, it maintains class differences through organic solidarity and in the context of South Africa, race and social class have always been closely

related. (It therefore remains an open question as to what extent the new syllabus does redress social inequities of the past.)

8.3.3 Positioning and distribution of practices to transmitters

In the context of a theory of instruction that constitutes acquirers as autonomous learning subjects, teachers are positioned, in general, as facilitators of learning, rather than transmitters of knowledge. Since the pedagogic context appears to be dominated by pupils' activity, teachers are expected to organise the learning context such that all pupils have opportunities to express or display their individual competences. As such, teachers are expected to develop a wide repertoire of teaching styles and approaches. For example, one of the *principles* in the syllabus states:

> 1.4 [D]ifferent content types (e.g. concepts, relationships, generalisations, algorithms, terminology, notations) and different dimensions of understanding [...] require different learning and teaching styles and approaches. The programme should encourage reflection upon content, teaching styles and learning strategies and should provide for appropriate opportunities for:
> 1.4.1 direct teaching of individuals, groups and whole classes;
> 1.4.2 activity-based learning;
> 1.4.3 discussion between the teacher and pupils and between pupils themselves;
> 1.4.4 applications and problem-solving;
> 1.4.5 open-ended investigations; and
> 1.5.6 consolidation and practice.
>
> (WCED, 1997: 2)

Teachers too are thus constituted as highly competent individuals capable of selecting "appropriate teaching styles". In the above, it can be seen that direct teaching (1.4.1) is the only teaching style where the teacher's voice is positioned as dominant transmitter. In the other teaching styles, learner voices would be valued much the same as the teacher voice. The teacher "facilitates" and "encourages" learning during these activities, but should not give answers or take over through direct teaching of the contents being explored. In the more detailed descriptions of syllabus contents, the teacher's voice is positioned as secondary to the acquirer, in so far as the syllabus prescribes what learners should say or "discover", rather than what teachers should teach. For example, with regard to "multiplication and division without calculators", the notes in the syllabus state that "pupils should realise that for positive numbers multiplication by a number between 0 and 1 has a decreasing effect and division by

such a number and increasing effect" (WCED, 1997: 23). In other words, teachers must not teach this as a rule, but should rather provide opportunities for learners to observe the pattern and then come to this conclusion. Similarly with the classification of quadrilaterals and triangles. Rather than give definitions for these figures, pupils must be given opportunities to "sort triangles and quadrilaterals in various ways and give reasons for each sorting" (ibid: 28). There are several more examples of this type, which suggests that teachers have to be skilled in being able to select/design activities that would facilitate learning of specific contents. They are expected to use their discretion not only to vary the learning activities but also to decide on the sequencing of contents:

> The arrangement of the content of the syllabus and its subdivisions is not necessarily an indication of the sequence in which the work should be handled. Where appropriate, various concepts and skills could be integrated at the teacher's discretion. [...] Set concepts (relations, operations and notation) should, where necessary and appropriate, be introduced (WCED, 1997: 5).

Teachers are thus constituted as competent professionals, capable of sequencing subject contents at their discretion, varying their teaching styles and selecting appropriate learning activities. Their professional responsibility includes selecting assessment procedures and appropriate criteria and again, teachers are expected to use their discretion:

> It is essential that the assessment programme should reflect the broad classroom approaches to the teaching and learning of mathematics. Since these approaches involve oral, written and practical skills, the assessment of pupils' progress should give credit in all these areas. [...] For all assessment forms, teachers need to decide on appropriate criteria and make these clear to pupils and parents. [...] Having decided on criteria for competence, the teacher will have to map out indicators of this competence so that s/he can design a marking grid (ibid: 14).

So while syllabuses containing pedagogic prescriptions are handed down to teachers, the latter are constituted as autonomous professionals with expert knowledge of their own classrooms. In other words, syllabuses pertain to classes in general and the teacher has to interpret the syllabus to suit his/her particular classroom conditions and experiences. Since there is a de-emphasising of direct teaching, assessment requires more than asking for recalling knowledge taught. Consequently, teachers are encouraged to develop mechanisms for reading and predicting individual pupils'

behaviours in order to assess them more effectively. For example, being able to assess whether a pupil is articulate, whether s/he participates constructively in class, whether s/he displays creative and independent mathematical thinking etc. Divising and using different forms of assessment is geared towards assessing the range of strengths that individual pupils might have. The teacher as competent professional is thus well suited for a pedagogic context in which pupils are encouraged to investigate, be inquisitive, be critical, express themselves creatively, make conjectures and so forth. The teacher must be competent enough to respond to pupils in all these situations.

The description of teachers in the new syllabus resembles the description of white teachers in the reports. That is, teachers who are constituted as highly competent, autonomous organisers of the pedagogic context and who have a sound professional training that includes mathematical and pedagogic knowledge. Within the pedagogic context, acquirers are to be individuated and teachers must assist in this. They must have the necessary knowledge to identify and respond to the "needs" of individual acquirers. Again, there is no distinction between black or white teachers, nor any suggestion that teachers have to teach only pupils who have similar "cultural" backgrounds as themselves. In the context of the new syllabus, this might suggest that the teacher, trained professionally, with sound mathematical and pedagogic knowledge, can overcome "cultural" differences, not only between the teacher and pupils, but also between pupils. Mechanisms available to teachers for achieving this include varying their teaching and assessment styles in order to cater for acquirers "who learn in a variety of ways", "who learn at different rates" and who come to the learning situation with "different experiences" (WCED, 1997: 13). These may be seen as consistent with the societal aims "to develop equal opportunities and choice" and "to contribute to the widest development of the society's cultures".

The similarity between white teachers constituted in the reports and generalised teachers in the syllabus hinges on the fact that in both cases teachers are expected to cope with differences between pupils and have to strive towards developing individual potential of pupils and to prepare them for a diversity of post-school occupations.

Black teachers were constituted very differently in the reports, since they were expected to deal with an undifferentiated group of pupils following limited career trajectories. In the new syllabus all teachers must assist pupils in individuating themselves. The identities of black teachers do not hinge on the communities from which they come, nor is it a pre-requisite that they must be familiar with the communal aspirations of their pupils. Rather, black teachers are to become as professionalised as white teachers and as skilled at dealing with individual differences between acquirers. It is therefore the case that the new syllabus implies changes in practice only for black teachers while providing white teachers with additional suggestions for structuring a pedagogic context to cope with individual differences between acquirers. Table 8.1 summarises suggested differences with respect to transmitters, acquirers, pedagogic contexts and mathematics, between theories of instruction in the reports and the new syllabus document.

In this study I have analysed curriculum proposals in the 1970s in South Africa and have found some resonance with the social structure in the broader society at that time. Looking at current curriculum proposals one may argue that there is again resonance with the broader social structure at this time. In the present climate, social equality must translate into equal access and opportunity, differences in society are to be celebrated and the cohesion of the society is to be sustained through relations of interdependence. All acquirers are thus to be individuated and teachers are to assist in this. The similarities and differences between curriculum proposals in the reports and the new syllabus suggest that at the present time, rhetorically, the social function of education for blacks encompasses new meanings that include the (re)production of individualised identities for acquirers and professionalised identities for transmitters. The social function of education for whites has remained the same. It may thus be argued that the rhetoric of social equality is to be promoted within a context of interdependent relations with which white acquirers and transmitters presumably are already familiar but which is alien to black acquirers and transmitters. It remains to be seen how the implementation of this new syllabus, that is, how it is taken up in classroom practice, will achieve social equality.

Suggested differences between HSRC reports and a 1996/7 syllabus

Theories of instruction with respect to:	HSRC Reports	1996/7 syllabus
Transmitters and associated knowledge and practices	*White*: Professional, with sound mathematical and pedagogic knowledge; teach to meet the needs of individual acquirers. *Black*: Knowledge of organising mine work teams; knowledge of practices and 'culture' of the black community; must teach to enculturate black learners into practices of black community.	Undifferentiated generalised transmitter; acts as facilitator in the classroom; draws on a range of teaching styles; mathematically and pedagogically competent; must assist in individuating learners.
Acquirers and associated knowledge and practices	*White*: differentiated on the basis of IQ, learning readiness and a host of personal attributes; develop individualised identities; select from a range of mathematical courses; prepared to occupy a wide range of careers. *Black*: undifferentiated homogeneous group; follow a practical mathematics course; identities shaped by the collective unconscious of the group; prepared to occupy semi- and unskilled labour.	Undifferentiated generalised acquirer, who is always competent; acts as an autonomous and independent learner; must develop a range of learning strategies; develop individualised identities; prepared to inhabit a complex division of labour in society
Pedagogic contexts and social relations for acquirers	*White*: organic solidarity sustained through relations of interdependence between individual acquirers. *Black*: mechanical solidarity sustained through "similar to" relations of shared competences.	Undifferentiated pedagogic contexts in which organic solidarity is sustained through relations of interdependence between individual acquirers.
Mathematics	Differentiated mathematics syllabuses, with a strong emphasis on the utilitarian value of mathematics; mathematics to be a vehicle for social differentiation.	Undifferentiated mathematics syllabus, with an emphasis on the personal value of mathematics for acquirers; mathematics to be a vehicle for social equality.

Table 8.1

8.4 Conclusion

This study has looked at the mathematics curriculum in South Africa realised only in policy texts and not in the reality of schooling. In the HSRC reports, the mathematics curriculum is (re)produced as a vehicle for social differentiation. In contrast, the new curriculum celebrates diversity and promotes unity in a new SA. This is at the level of rhetoric. What happens on the ground is a different story. Studies by Ensor (1996) and Dowling and Brown (1996, 1997) have begun to suggest that conditions that currently prevail in historically racially separated schools will mean that take up of the new curriculum will be different in different schools. Their studies suggest that in practice, pedagogic contexts are not undifferentiated. For example, Ensor (1996) examines beginning teachers, fresh with new ideas for teaching mathematics, who enter schools that operate in very different contexts. She suggests that "the constraints and possibilities confronting these beginning teachers mirror many of the same challenges facing curriculum innovation at the present time" (Ensor, 1996: 112). Her descriptions of teachers' practices in the different contexts supports the view that in white schools teachers constitute a professional teaching core who are supportive of each other and who are accustomed to drawing on a variety of resources and developing a wide repertoire of teaching styles to cope with differences between individual acquirers. In black schools teachers lack similar resources and draw on much more limited repertoires. In many black schools, the "culture of learning" has broken down to such an extent that teaching simply does not take place. Dowling and Brown (1996) focus on the constitution of pedagogic communities in different school contexts in SA[9] and similarly describe differences relating to pedagogic relations and practices within the different contexts. Working in broadly the same framework as my own, they suggest that at white schools pedagogic relations are sustained through interdependence and are therefore closer to organic solidarity while at black schools relations are sustained through the collective unconscious of the community and therefore closer to mechanical solidarity. While these studies by Ensor (1996) and Dowling and Brown (1996) are initial studies and by no means complete, they raise

[9] They look at schools formerly governed by white, coloured and African departments of education in the Western Cape.

questions, opened up also in this study, about the take up of new curricula in historically racially separated schools and raise challenging questions for further research around the possibilities for the new curriculum to overcome existing social inequalities.

The endeavour in this study to produce a theoretically coherent analysis will, it is hoped, make a modest contribution to the sparse field of curriculum analysis in South Africa. It is hoped that the use of Dowling's (1995) language as a methodological framework has illustrated its usefulness in relation to non-pedagogic texts and has illustrated its generality as a methodological tool for analysing texts. Above all, it is hoped that the analysis of commissioned research into mathematics education in the 1970s conducted here, holds some significance for the historical development of mathematics curricula in South Africa.

References and Bibliography

ADLER, J. (1991/2) "Politics and Practice in Mathematics Education" in *Perspectives in Education*, Vol 13 (1), (pp 21-31)

ADLER, J. (1992) "What is new and different in the draft core syllabus for mathematics: std 2 - 4?" in *Pythagoras*, 28, (pp 26-32)

ADLER, J. (1993) "Moving beyond apartheid or more of the same? Political dimensions of national examining at te Std. 7 level" in *Pythagoras*, 32, (pp 29-34)

ADLER, J. (1994) "One teacher one method" in Brodie, K. & Strauss, J. (eds) *AMESA First National Congress and Workshop Proceedings*, Johannesburg, University of the Witwatersrand

APPLE, M.W. (1992) "Education, culture, and class power: Basil Bernstein and the neo-Marxist sociology of education" in *Educational Theory*, Vol 42 (2) (pp 127-145)

APPLE, M.W. (1993) "The Politics of Official Knowledge: Does a National Curriculum make sense?" in *Discourse*, Vol 14 (1) (pp 1-15)

ATKINSON, P. (1985) *Language, Structure and Reproduction: An introduction to the sociology of Basil Bernstein*, London: Methuen

BAKER, B. (1996) "The History of Curriculum or Curriculum History? What *is* the Field and Who Gets to Play on it?" in *Curriculum Studies*, Vol 4 (1)

BALL, S.J. (1983) "Imperialism, Social Control and the Colonial Curriculum in Africa" in *Journal of Curriculum Studies*, Vol 15 (3) (pp 237-263)

BALL, S.J. (ed) (1990) *Foucault and education: Disciplines and knowledge*, London, Routledge

BALL, S.J. (1993) "Education, Majorism and "the Curriculum of the Dead"" in *Curriculum Studies*, Vol 1 (2) (pp 195-214)

BALL, S.J. (1993) "What is Policy? Texts, Trajectories and Toolboxes" in *Discourse*, Vol 13 (2) (pp 10-17)

BALL, S.J. (1994) *Education Reform: A critical and post-structural approach*, Open University Press, Buckingham

BARTHES, R. (1981) "Theory of the Text" in Young, R. (ed.) *Untying the Text: a poststructuralist reader*, London: Routledge & Kegan Paul

BEHR, A.L. (1988) *Education in South Africa Origins, Issues and Trends: 1652-1988*, Academica

BERNSTEIN, B. (1990) *Class, Codes and Control Volume IV: the structuring of pedagogic discourse*, London: Routledge

BERNSTEIN, B. (1996) *Pedagogy, Symbolic Control and Identity*, London, Taylor & Francis

BOWE, R., BALL, S.& GOLD, A. (1992) *Reforming Education & Changing Schools: Case Studies in Policy Sociology*, Routledge, London & NY

BREEN, C. (1991/2) "Teacher Education and Mathematics: Confronting Misconceptions" in *Perspectives in Education*, Vol 13 (1), (pp 33-44)

BROWN, A. (1990) "From Notional to National Curriculum: The Search for a Mechanism" in Dowling, P.C. & Noss, R. (eds.) *Mathematics versus the National Curriculum*, Basingstoke: Falmer Press

CARLGREN, I. (1995) "National Curriculum as Social Compromise or Discursive Politics? Some Reflections on a curriculum-making process" in *Journal of Curriculum Studies*, Vol 27 (4) (pp 411-430)

CARTER, B. & BURGESS, H. (1993) "Testing, Regulation and Control: shifting education narratives" in *Curriculum Studies*, Vol 1 (2) (pp 233-244)

CEPD (1994) *Implementation Plan for Education and Training - Task team: Teacher development and support (Final Report, 15 May 1994)*: Centre for Education and Policy Development

CHRISTIE, P. (1985) *The Right to Learn*, Johannesburg:Ravan Press& Sached Trust

CHRISTIE, P. (1994) "South Africa in Transition: Education Policies, 1990-93" in *Discourse*, Vol 14 (2) (pp 45-55)

CODD, J (1988) "The Construction and Deconstruction of Educational Policy Documents" in *Journal of Educational Policy*, Vol 3 (3) (pp 235-247)

COOPER, B. (1983) "On Explaining Change in School Subjects" in *British Journal of Sociology*, Vol 4 (3) (pp 207-222)

COOPER, B. (1985) *Renegotiating Secondary School Mathematics: A Study of Curriculum Change and Stability*, London, The Falmer Press

COOPER, B. (1996) "Response to: Pedagogy and Community in Three South African Schools: A Classroom Study". Response presented at RSPME, 13th June, 1996

DANZIG, A.B. (1992) "Basil Bernstein's sociology of language applied to education: deficits, differences and bewitchment" in *Journal of Educational Policy*, Vol 7 (3) (pp 285-300)

DAVIS, Z. (1994a) "Using the notion of *Discourse* in mathematics education" in Davis, Z. (ed.) *Explorations in Mathematics Teaching and Teacher Education*, Cape Town: Mathematics Education Project, School of Education, University of Cape Town

DAVIS, Z. (1994b) "Myth and mathematics: an analysis of the IEB ABE Level 3 User Guide 2" in Davis, Z. (ed.) *Explorations in Mathematics Teaching and Teacher Education*, Cape Town: Mathematics Education Project, School of Education, University of Cape Town

DAVIS, Z. (1995) "The Recontextualising of pedagogic discourse: a case study drawn from an inservice mathematics project". Unpublished Masters Dissertaion, University of Cape Town

DAVIS, Z. (1996) "A Language for the Sociological Description of Interactive Pedagogic Texts with Particular Reference to the Primary School Mathematics Scheme Mathematics at Work and the "Problem-centred Approach". Phd Proposal, University of Cape Town, January 1996

DEACON, R. & PARKER, B. (1995) "Education as Subjection and Refusal: an elaboration on Foucault" in *Curriculum Studies*, Vol 3 (2) (pp 109-121)

DEAN, M. (1994) *Critical and Effective Histories: Foucault's Methods and Historical Sociology*, London: Routledge

DEPARTMENT OF EDUCATION AND CULTURE (1993) *Working Document for Mathematics, Standards 2-4*, Department of Education and Culture: House of Assembly

DEPARTMENT OF EDUCATION AND CULTURE (1995) "White Paper on Education and Training", *Government Gazette*, Vol 357 (16312), 15 March 1995

DOWLING, P.C. & NOSS, R. (eds.) (1990) *Mathematics versus the National Curriculum*, Basingstoke: Falmer Press

DOWLING, P.C. (1990) "The Shogun's and Other Curricular Voices" in Dowling, P.C. & Noss, R. (eds.) *Mathematics versus the National Curriculum*, Basingstoke: Falmer Press

DOWLING, P.C. (1992) "Textual production and Social Activity: a language of description" in *Collected Original Resources in Education 16(1)*

DOWLING, P.C. (1993) "Theoretical 'Totems': a sociological language for educational practice" in Julie, C., Angelis, D. & Davis, Z. (eds.) *Political Dimensions in Mathematics Education: curriculum reconstruction for society in transition*, Cape Town: Maskew Miller Longman

DOWLING, P.C. (1995) A Language for the Sociological Description of Pedagogic Texts with Particular Reference to the Secondary School Mathematics Scheme *SMP 11-16, Collected Original Resources in Education*, 19

DOWLING, P & BROWN, A. (1996) "Pedagogy and Community in Three South African Schools: A Classroom Study". Paper presented at RSPME, 13th June, 1996

DRAKE, P. (1990) "Training Teachers in Crisis: A Case Study of a Part-time Postgraduate Certificate in Education" in Dowling, P.C. & Noss, R. (eds.) *Mathematics versus the National Curriculum*, Basingstoke: Falmer Press

DREYFUS, H.L. & RABINOW, P.(1982) *Michel Foucault: beyond structuralism and hermeneutics,* Brighton: Harvester

DURKHEIM, E. (1984) *The Division of Labour in Society*, Basingstoke: MacMillan

DU TOIT, D. (1994) "Natal Education Department: Model of Curriculum Development for Primary Mathematics" in Levy, S. (ed.) *Projects speak for themselves*, Pietermaritzburg: Shuter & Shooter

ENSOR, P. (1993) "Boundaries at the Centre: Differentiating Pupils in Mathematics Classrooms" in Julie, C., Angelis, D. & Davis, Z. (eds.) *Political Dimensions in Mathematics Education: curriculum reconstruction for society in transition*, Cape Town: Maskew Miller Longman

ENSOR, P. (1994) "Teacher as change agent or bricoleur? Issues in the initial education of mathematics teachers" in Davis, Z. (ed.) *Explorations in Mathematics Teaching and Teacher Education*, Cape Town: Mathematics Education Project, School of Education, University of Cape Town

ENSOR, P. (1996) "'Learning to teach' in the new South Africa" in *Proceedings of The Association for Mathematics Education in South Africa (AMESA), Second National Conference*, Cape Town, July 1996

ENSOR, P. (1996b) "Looking Straightforwardly, Looking Awry: Taking a View on the Subject of Interviewing". Paper presented at Kenton Education Association Conference, Wilgespruit, October 1996

ERNEST, P. (1991) *The Philosophy of Mathematics Education*, London: Falmer

ERNEST, P. (1993) "Constructivism and the Problem of the Social" in Julie, C., Angelis, D. & Davis, Z. (eds.) *Political Dimensions in Mathematics Education: curriculum reconstruction for society in transition*, Cape Town: Maskew Miller Longman

EVANS, J., DAVIES, B. & PENNEY, D. (1994) "Whatever Happened to the Subject and the State in Policy Research Education" in *Discourse*, Vol 14 (2) (pp 57-64)

FOUCAULT, M. (1972) *The Archeology of Knowledge*, London: Routledge

FOUCAULT, M. (1977) *Discipline and Punish: the birth of the prison*, London: Penguin

FOUCAULT, M (1981) "The Order of Discourse" in R. Young (ed) *Untying the Text: A Post-Structuralist Reader*, London: Methuen
FOUCAULT, M (1982) "The Subject and Power" in *Critical Inquiry* Vol 8, (pp 777-795)
GLENCROSS, M. (1991) "A New Mathematics Curriculum for a New South Africa" in *Pythagoras*, 25 (pp 8-11)
GOLDSTEIN, H (1990) "The Fundamental Assumptions of National Assessment" in Dowling, P.C. & Noss, R. (eds.) *Mathematics versus the National Curriculum*, Basingstoke: Falmer Press
GOODSON, I. (1982) *School Subjects and Curriculum Change: Case Studies in the Social History of Curriclum*, London, Croom Helm
GOODSON, I. (1983) "Subjects of Study: Aspects of a Social History of Curriculum" in *Journal of Curriculum Studies*, Vol 15 (4) (pp 391-408)
GOODSON, I. (1988) *The Making of Curriculum: Collected Essays*, London, Falmer Press
GOODSON, I. (1989) "'Chariots of Fire': Etymologies, Epistemologies and the Emergence of Curriculum" in Milburn, G., Goodson, I. & Clark, R.J. (eds) *Re-interpreting Curriculum Research : Images and Argument*, London, Falmer Press
GRIFFITHS, H.B. & HOWSON, G. (1982) Mathematics: Society and Curricula, Cambridge University Press
GRUNDY, S. (1994) "Being and Becoming an Australian: Classroom Discourse and the Construction of Identity" in *Discourse*, Vol 15 (1) (pp 16-31)
GRUNDY, S. (1994) "Which Way toward the Year 2000? Contrasting Policy Discourses in two Education Systems" in *Curriculum Inquiry*, Vol 24 (3) (pp 327-347)
HAWKEY, K. (1993) "Implementation of National Curriculum History and Geography at Key Stage Three: A Case Study" in *Curriculum*, Vol 14 (2) (pp 140-149)
HENRIQUES, J. (1984) *Changing the Subject: psychology, social regulation and subjectivity*, London:Methuen
HENRY, M. (1993) "What is Policy? A response to Stephen Ball" in *Discourse*, Vol 14 (1) (pp 102-105)
HOSKIN, K (1994) "Boxing Clever: For, Against and Beyond Foucault in the Battle for Accounting Theory" in *Critical Perspectives on Accounting,* 5, (pp 1-29)
HOWSON, G. KEITEL, C. & KILPATRICK, J. (1981) *Curriculum development in mathematics*, Cambridge University Press
HOYLES, C. (1990) "Neglected Voices: Pupils' Mathematics and the National Curriculum" in Dowling, P.C. & Noss, R. (eds.) *Mathematics versus the National Curriculum*, Basingstoke: Falmer Press
JANSEN, J. (1995) "Understanding Social Transition through the lens of Curriculum Policy: Namibia/South Africa" in *Journal of Curriculum Studies*, Vol 27 (3) (pp 245-261)
JARVIS, W.J. (1989) "Mathematics and the Modular Curriculum: The South African Situation" in *Pythagoras*, 19, (pp 15-18)
JOHNSTON, J. (1993) "The Construction of Mathematical Ability: An analysis of texts" *Unpublished paper*, presented at RSPME, Institute of Education, London
JULIE, C. (1991/2) "Equations of Inequality: Challenging the School Mathematics Curriculum" in *Perspectives in Education*, Vol 13 (1), (pp 3-10)

JULIE, C. (1992) 'Mev. Smit becomes a grandmother: a rejoinder to Jill Adler" in *Pythagoras*, 30, (pp 24-26)

JULIE, C., ANGELIS, D. & DAVIS, Z. (eds.) *Political Dimensions in Mathematics Education: curriculum reconstruction for society in transition*, Cape Town: Maskew Miller Longman

KALLAWAY, P. (1987) *Apartheid and Education - The Education of Black South Africans*, Johannesburg:Ravan Press

KIBI, A.K.M. (1993) "For People's Power" in Julie, C., Angelis, D. & Davis, Z. (eds.) *Political Dimensions in Mathematics Education: curriculum reconstruction for society in transition*, Cape Town: Maskew Miller Longman

KÜCHEMANN, D. (1990) "Ratio in the National Curriculum" in Dowling, P.C. & Noss, R. (eds.) *Mathematics versus the National Curriculum*, Basingstoke: Falmer Press

LARIDON, P. (1990) "Fundamental Curriculum Development Issues Relating to the Current Senior Secondary Syllabus Proposals" in *Pythagoras*, 22, (pp 19-24)

LARIDON, P. (1993) "Towards transforming mathematics education in South Africa" in *Pythagoras*, 31, (pp 40-45)

LEVY, S. (ed.) (1994b) *Projects speak for themselves* (second edition), Houghton / Peitermaritzburg: Sharon Levy / Shuter & Shooter

McBRIDE, M. (1989) "A Foucauldian analysis of mathematical discourse" in *For the Learning of Mathematics,* Vol 9 (1), (pp 40-6) Notes to the paper in *FLM 9(2)*, p. 31

McHOUL, A. & GRACE, W. (1993) *A Foucault Primer Discourse, power and the subject*, Melbourne University Press

MEERKOTTER, D. (1993) "The NECC and People's Education and Some Challenges Facing Curriculum Development for Democracy and Nation-Building: (Re)Constructing the South African Mosaic" in Julie, C., Angelis, D. & Davis, Z. (eds.) *Political Dimensions in Mathematics Education: curriculum reconstruction for society in transition*, Cape Town: Maskew Miller Longman

MOON, B. (1986) *The 'New Maths' Curriculum Controversy*, London, The Falmer Press

MOSOTHWANE, M. (1995) "The Study of Curriculum Change in Botswana with Special Reference to Primary Science: an historical perspective" in *Curriculum Studies*, Vol 3 (1) (pp 79-89)

MULLER, J. & TAYLOR, N. (1993) "Into other wor(l)ds: curricular knowledge in the making" in Taylor, N. (ed.) *Inventing Knowledge: Contests in Curriculum Construction*, Cape Town: Maskew Miller Longman

MULLER, J. & TAYLOR, N. (1995) "Knowledge, The School Curriculum and Everyday Life" in McKay, V. (ed) *A Sociology of Educating*, Johannesburg: Lexicon

MULLER, J. (1987) "Much Ado: "manpower shortages" and educational policy reform in South Africa" in *Journal of Educational Policy*, Vol 2 (2) (pp 83-97)

MULLER, J. (1996) "Dreams of Wholeness and Loss: critical sociology of education in South Africa", in *British Journal of Sociology of Education*, Vol 17 (2) (pp 177-195)

NATIONAL EDUCATION POLICY INVESTIGATION (1992) *Curriculum*, Cape Town: Oxford

NOSS, R. (1989) "Just Testing: A Critical View of Recent Change in the United Kingdom School Mathematics Curriculum" in Ellerton, N. & Clements, M. A. (eds) *School Mathematics: The Challenge to Change*, Deakin University Press

NOSS, R. (1990) "The National Curriculum and Mathematics: A Case of Divide and Rule?" in Dowling, P.C. & Noss, R. (eds.) *Mathematics versus the National Curriculum*, Basingstoke: Falmer Press

O'DONOGHUE, T.A. & ASPLAND, T. (1994) " Teachers' Curriculum Dilemmas in a Climate of Restructuring: A Western Australian Case Study" in *Curriculum*, Vol 15 (2) (pp 77-85)

O'REILLY, D. (1990) "Hierarchies in Mathematics: A Critique of the CSMS" in Dowling, P.C. & Noss, R. (eds.) *Mathematics versus the National Curriculum*, Basingstoke: Falmer Press

PACHOCINSKI, R. (1993) "Current Curriculum Changes in Poland: a national report" in *Curriculum Studies*, Vol 1 (2) (pp 215-232)

PARKER, D (1995) "Knowledges and Subjects: key conceptions in mathematics curriculum innovation". Paper presented at SAARMSE Conference, University of Cape Town, January 1995

POPKEWITZ, T (ed) (1987) *The Formation of the School Subjects: The Struggle for Creating an American Institution*, London, Falmer Press

POWELL, L. (1996) "The Impact of Commisioned Research on Policy - Assessing the Relationship". Paper presented at Kenton Education Association Conference, Wilgespruit, October 1996

POWER, S. (1992) "Researching the impact of education policy: difficulties and discontinuities" in *Journal of Educational Policy*, Vol 7 (5) (pp 493-500)

RAGHAVAN, P. (1994) "Social constructivism: its implications to mathematics education in South Africa" in Brodie, K. & Strauss, J. (eds) *AMESA First National Congress and Workshop Proceedings*, Johannesburg, University of the Witwatersrand

SCHUBER, W.H. (1990) "Curriculum Cntralisation and Decentralisation: Historical Perspective" in *Curriculum*, Vol 11 (2) (pp 65-69)

SILVER, H. (1990) *Education, Change and the Policy Process*, London, Falmer Press

SMITH, D. (1990) "Curriculum Reform in Australia: Retrospect and Prospect" in *Curriculum*, Vol 11 (2) (pp 70-79)

TAYLOR, N (ed) (1993) *Inventing Knowledge: Contests in Curriculum Construction*, Cape Town: Maskew Miller Longman

TAYLOR, N. (1991/2) "Difference and Discourse: Valerie Walkerdine and the Sociology of Mathematical Knowledge" in *Perspectives in Education*, Vol 13 (1), (pp 69-79)

UNTERHALTER et al (eds) (1991a) *Apartheid Education and Popular Struggles*, Johannesburg, Ravan Press

UNTERHALTER et al (eds) (1991b) *Education in a Future South Africa: Policy Issues for Transformation*, Oxford, Heinemann

VOLMINK, J. (1993) "A different mathematics education for a different South Africa?" in *Pythagoras*, 31, (pp 32-37)

VOLMINK, J. (1993) "When We Say Curriculum Change, How Far Are We Prepared To Go As A Mathematics Community" in Julie, C., Angelis, D. & Davis, Z. (eds.) *Political Dimensions in Mathematics Education: curriculum reconstruction for society in transition*, Cape Town: Maskew Miller Longman

WALLET, C. & PIAZZA, C. (1991) '"Perspectives on production of written and educational policy reports" in *Journal of Educational Policy*, Vol 6 (1) (pp 63-84)
WESTERN CAPE EDUCATION DEPARTMENT (1996/7) *Junior Secondary Course, Syllabus for Mathematics, Standards 5 to 7*, Western Cape Education Department, Cape Town (Implementation dates 1996 & 1997)
WERNER, W. (1991) "Defining curriculum policy through slogans" in *Journal of Educational Policy*, Vol 6 (2) (pp 225-238)
WEXLER, P. (1987) *Social Analysis of Education*, New York: Routledge
WHITE, C. & CRUMP, S. (1993) "Education and the Three 'P's: policy, politics and practice: A review of the work of S. J. Ball" in *British Journal of Sociology*, Vol 14 (4) (pp 415-429)
WOJCIECHOWSKA, A. (1989) "Curriculum reform in mathematics: beyond the impossible revolution?" in *Journal of Curriculum Studies*, Vol 21 (2) (pp 151-159)
YOUNG, M.F.D. (ed) (1971) *Knowledge and Control: New directions for the Sociology of Education,* London: Collier-Macmillan
YOUNG, M.F.D. (1993) "A curriculum of the future? The case of post-compulsory education in the UK" in Taylor, N (ed) (1993) *Inventing Knowledge: Contests in Curriculum Construction*, Cape Town: Maskew Miller Longman